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The AUTOMOBILE

Setting for the 500-Mile Race

Meeting the 300-Cubic-Inch Limit—Entries Represent Culmination of Racing Development—American Cars Have Made Big Strides in Past 12 Months

By A. Ludlow Clayden

THE thing which will be watched with the greatest interest in the coming 500-mile race at Indianapolis Speedway is the bunch of new American cars in which there is to be found the best work that has ever been done in this country. It is the first time that American automobile engineers have devoted their closest attention to the job of producing high-speed motors for high-speed cars and they have had the aggregate experience of all the world upon which to draw.

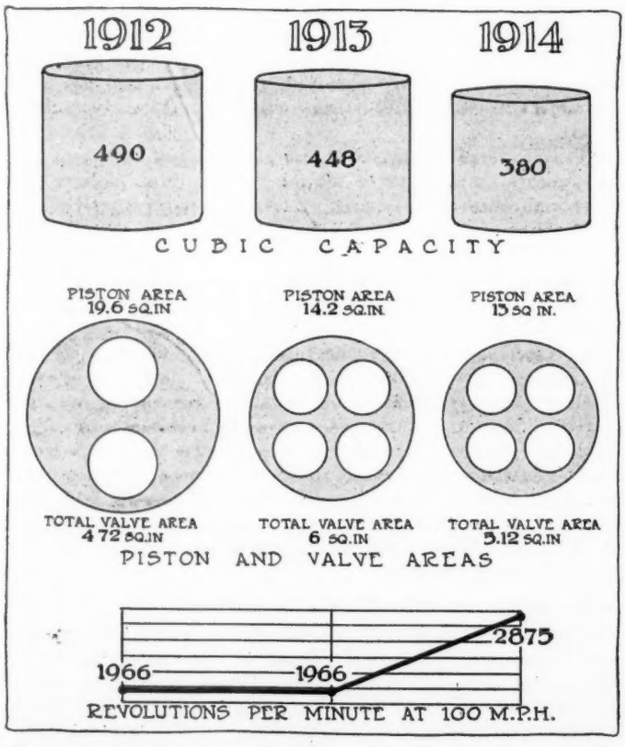


Chart showing the trends in piston displacement, valve-to-piston area and rotative speeds

There is no reason why one or more of these cars should not be able to do as well or better than the best European jobs, for as much skill and as much care have been incorporated in them. Certainly the American manufacturers have never before given so much time and money in their efforts to win what will be the most important automobile race held this year in any part of the world. Whether he be laboring in a factory or with the armies in the field, there is hardly a follower of the sport of motor racing whose thoughts will not turn to the Hoosier city and who will not be eager to hear the result. An American success this year would gain far more for the reputation of American automobile engineering than it could ever have before, and it may be doubted whether such a chance will ever occur again.

During the past 4 years a great change has occurred in the general character of racing automobiles. Before that time the usual idea was to employ the biggest motor possible and to gear it high, obtaining power by high compression and vigor of each individual explosion. Then, as race after race in Europe and America came to be put upon a motor-capacity basis, engineers found that even higher track speed was to be had from smaller motors turning at high speeds. We have seen the limit of cubic capacity at Indianapolis shrink from 600 cubic inches in 1911 and in 1912 to 450 in 1913 and 1914; now, this year, it is 300 cubic inches only. In these 4 years the winners' speeds were 74.8, 78.7, 75.9, and 82.5, so one can see that the big reduction from 600 cubic inches to 450 had a power-reducing effect the first year it came into force, but that last year the smaller motor was capable of higher speed than the best performance of the 600 cubic inch car.

Great Progress in American Motors

It was said last year by the Peugeot engineers that they had found great difficulty in getting more power per cubic inch in their cars for the French grand prix than they had

Performance of Motors in Indianapolis Winning Cars

GEAR	CAR	Number of Cylinders	Bore and Stroke	Cubic Capacity	Piston Area, Square Inches	Area of Valve, Square Inches	Ratio Piston Area, Valve Area	Piston Speed Feet per Minute at 100 M.P.H.	Revs. per Minute at 100 M.P.H.	Cubic Feet Gas Used per Mile	Gas Speed Through Valve at 100 M.P.H. Ft. per Second	Gear Ratio	Winner's Speed, M.P.H.
1912 Limit 600 Cu. In.	National	4	5x6.25	490	19.6	2.36 2 valves per cylinder	1/8.3	1022	1066	325	142	2 to 1	78.7
1913 Limit 450 Cu. In.	Peugeot	4	4.25x7.87	448	14.2	1.5 4 valves per cylinder	1/9.5	1307	1066	305	207	2 to 1	75.9
1914 Limit 450 Cu. In.	Delage	4	4.1x7.12	380	13	1.28 4 valves per cylinder	1/10	1704	2875	379	284	3 to 1	82.47

obtained in 1913, and the cars which ran last year were very little faster on the straightaways than those which had competed in the great French classic in 1913. At Indianapolis this year we shall see the two fastests cars from Lyons in De Palma's Mercedes and Resta's Peugeot, but they will probably be no faster than they were 12 months ago. Among the native machines, however, there are many of designs at least as good as and perhaps better than these year-old European cars, for American engineers have been busy while their European confrères have been idle through force of circumstances.

How High-Speed Motor Gets Power

At the foot of this page is a table giving the main characteristics of the motors used at Indianapolis in 1912, 1913 and 1914. In it there is a column giving the cubic feet of gas used per mile and, looking at this, it is easy to see whence came the power which enabled a car with a motor of 380 cubic inches to eclipse the speeds got from much larger engines in previous years, for the ultimate measure of the power of a motor is, of course, its ability to burn combustible gas. The greater the quantity of gas mixture it can inhale and explode per minute the greater will be the power it gives out.

It should be explained that the ability of the different motors to use gas is estimated by determining the number of motor revolutions per mile run; which is fixed by tire size and gear ratio; and multiplying the revolutions by the capacity of the motor in cubic feet. This does not give the *actual* figure for the gas used, as this depends upon many details of design, but it does represent the theoretical best possible performance in true proportion. Probably if there were any method of measuring the real consumption of gas we should find that the better mechanical detail of the 1914 winner made its position still better than the figures given suggest it to have been.

Gas Speed Increased 100 per Cent.

Figuring on a basis of 100 miles per hour, which was attained frequently during the races at Indianapolis, we find that the piston speeds are roughly in the proportion 10-13-17 for the last 3 years—an increase of 70 per cent. in 2 years, and figuring the gas velocities at maximum valve lift the speed of mixture rushing in rose from 142 feet per second to 284 feet, an increase of exactly 100 per cent. Here again the probability is that the valves of the 1914 winner remained open longer than that of the 1912 car, so the average velocity during the whole time the intake valve was open is probably not so much greater on the newer car as these figures show. Still they suffice to point the moral that we can burn more fuel and so have a larger number of thermal units of energy at our command with a little, high-speed motor than with a large one running at two-thirds the speed.

This year it is almost safe to expect that we shall see higher crankshaft speeds, higher gas speeds, greater displacement per mile and a higher average speed for the winning car, unless the condition of the track or some such extraneous cause shall occur to prevent the full power of the motors being available. As speeds are reached that compel the driver to shut off for the bends, it is not so much the possible *maximum* speed which counts as the rapidity of *acceleration*, and other things besides crankshaft speed and valve areas enter into this.

$$\text{Acceleration} = \frac{\text{Power}}{\text{Weight}}$$

Acceleration, the rapidity with which speed of motion can be imparted to a body, depends upon the mass of the body, the resistance offered to its motion and the force available to move it. Taking resistance to motion first we can reduce the rolling resistance of the car by care to see that every bearing in the wheels and transmission is in perfect state, that only the best of bearings are used and the best of lubricants. The most important external resistance is that of the atmosphere and this is cut down by the modern style of bodywork, the streamline seating and sometimes the tapering tail used universally in track racing in Europe, and to be found upon the Peugeot which Resta will drive this year. In general the value of the tail is debatable, for though the theory behind its use is sound there are other effects due to the weight and the effect of side wind. But there is general agreement as to the help obtained by a smooth and streamline midships section and a hood which tapers neatly to the seats.

When all these things have had attention we can come to the question of mass to be moved. For a fixed amount of power and other things equal, as they say in the text books, we shall get a quicker acceleration as we reduce the weight of the car. The car as a whole possesses inertia, and force is needed to change its speed of motion, the less the weight the less the inertia. So we gain the idea that it is an advantage to build the car as light as possible.

However, it is not only the mass of the car as a whole that matters, for besides the inertia effect of the complete vehicle, every part within it that has a rotary motion has an individual inertia. It requires force to accelerate the flywheel, the clutch, the road wheels and even the gears and shafts. So there is a powerful incentive to cut down every part, first, because of its own inertia, and, second, because of its part in making up the total weight. Thus one reason for using six-cylinder cars for racing is because they do not need so heavy a flywheel.

Special Materials Reduce Weight

A conspicuous feature of the majority of the racing motors made specially for the 1915 contest is the use of the new high tensile aluminum alloys. For pistons, connecting rods, and even for chassis frames in some instances, one finds steel and iron replaced by one or other of the light metals which have practically the same strength. These materials are not cheap; mostly they are very costly indeed, and some

of them are difficult to work, but the saving in weight which they permit is worth both time and trouble.

Cooling a Difficult Problem

After care for the internal freedom of the motor we come to the cooling, and it may be that this is the most difficult part of the whole business, because we have to prevent the gradual heating up of such parts as valves after long hours of work. It might be thought that a motor which will cool itself efficiently for half an hour at full speed on a warm day ought to be proof against overheating for runs of days or even weeks, that failure when it came would be through something wearing out and not through a part becoming too hot. But experience of racing shows that parts, which have stood up for hours of practice spins at maximum speed but of short duration when considered singly, will fail when called upon to operate hour after hour without a rest. Notable among such parts are valves, valve springs and spark plugs, others being pistons and even cylinders.

It is known that an air-cooled motor cycle can always be made to suffer from overheating if it is run at maximum speed for long enough. This is because it gains heat from within just a little bit faster than it can dissipate it to the atmosphere. Now, if we imagine a part of a motor like a valve which is not cooled by direct contact with the water it may work perfectly at 250 degrees but fail at 350. Suppose that the amount of heat it can dissipate through the guide and seating is exactly equal to the heat it gains per minute when the motor is running at a certain power, if we speed up a little it will be getting more heat put into it than it can get rid of. It may be only a very little more, so that in a half hour its temperature will rise perhaps to 280 degrees, still below the danger point, but if the speed is maintained long enough the critical 350 degrees can be reached and failure becomes probable. These figures are, of course, only taken to illustrate the idea.

The reason for explaining this point is that the absence of steam at the radiator does not prove the cooling to be sufficient, we might easily so design an engine that some internal part would burn up with the cylinder jackets dead cold. These troubles with details like valves and plugs were encountered on the old style racing cars because materials failed through repeated stressing and the plug trouble was almost completely cured by better construction of that vital detail. Then, when we began to burn much more gas per minute in a much smaller motor, the heat trouble showed up and it is the most serious one that now faces the designer of modern racing machines.

Overhead Valves Advantageous

Every racing car to win an important event in Europe during the last two years has had overhead valves, and the majority of these cars have had four valves per cylinder. This is because the overhead construction gives a better shaped combustion space, a more free outlet for the gas past the valves and allows the use of a slightly higher compression. Also, and this is possibly important in view of the heating trouble dealt with in the last paragraph, it is more easy or less difficult properly to cool the valves and spark plug when the side pocket is removed.

The reason for using four small valves instead of two large ones is that they weigh less for a given area of opening. If we have heavy valves of large diameter it is necessary to use very strong springs and this puts heavy stresses on every part of the motor. It loads the push rods, cams and camshaft and the valve itself can be injured by the terrific impact as it shuts on its seating time after time at high speed. The amount of power absorbed by the valves and their operating mechanism is quite considerable and it needs much less to move two little valves than one large one, while trouble with bearings, timing gears and push rods is avoided. If we were still using big motors there would no doubt be engines with six or eight valves per cylinder, for the multiple valve idea has been a complete success. Opinions as to the best way to operate overhead valves differ a good deal, but the one which will reduce the weight of rockers or push rods to the minimum is generally preferred and this calls for an overhead camshaft or even two camshafts side by side on top of the motor as used by Peugeot.

Multi-Point Ignition Popular

It is generally conceded that there is advantage in the use of two magnetos and two sets of spark plugs, while some motors in successful racing cars have had four plugs per cylinder. Not only do the two plugs give quicker burning of the charge, but there is always the chance that one will continue in operation if the other fails. Apart from this, and the use of highly special spark plugs, there is little in a racing ignition system that differs from those in ordinary use.

Carburetion Troubles

The effect of high gas speeds and the very rapid opening and closing of the valves has been to make necessary a variety of changes in carbureter construction with the idea of obtaining a better gas. It is now a matter of history how that old veteran of carburetion, Claudel of Paris, just prior to the French grand prix, which was contested at Dieppe in 1912, evolved a new kind of carbureter which enabled a greatly increased power to be obtained from almost any sort of motor. The new instruments were made by hand for all the French cars and the English Sunbeams, while Monsieur Claudel himself superintended the tuning up of practically each of these engines.

The results were amazing, but it was then thought that the effect was obtained more by the skill of the man than the excellence of the carbureter. Later this proved to be untrue, for it was found possible to make the carbureter in quantity, and last year in Europe there was scarcely a car used in racing that had not either a regular Claudel carbureter or a "special" type of carbureter, made on the new Claudel principle. It is well known that in some of the French races carbureters bearing various names were all the same inside, Claudels with some other name on the float chamber lid.

The essence of this carbureter is a "jet" composed of a series of thin concentric tubes pierced with small holes. Air and gasoline are both drawn to the inside of these tubes through the narrow spaces which separate one from another, and there they intermingle so closely that there emerges from the little holes in the outer tube a thick rich gas and not a liquid spray at all. Much the same principle is involved in the well-known Zenith double jet, and in a variety of other carbureters. What Claudel did was to carry the thing a stage beyond what had ever been thought possible before. His racing carbureter has, however, a drawback, in that it cannot be fitted to any motor without a deal of experiment and trial to get just the right number and size of minute holes in the little battery of tubes.

It may, perhaps, be supposed that in the old kind of slow

Final Positions of Six-Cylinder Cars in Previous 500-Mile Races

1911		1912		1913		1914	
Marmon	6	National	4	Peugeot	4	Delage	4
Lozier	4	Fiat	4	Mercer	4	Peugeot	4
Fiat	4	Mercer	4	Stutz	4	Delage	4
Mercedes	4	Stutz	4	Sunbeam	6	Peugeot	4
Marmon	4	Schacht	4	Mercedes	4	Stutz	4
Simplex	4	Stutz	4	Grey Fox	4	Excelsior	6
National	4	White	6	Mercedes	4	Sunbeam	6
Amplex	4	Lozier	4	Case	4	Beaver Bullet	4
Knox	6	National	4	Mason	4	Maxwell	4
Jackson	4	Knox	6	Tulsa	4	Duesenberg	4

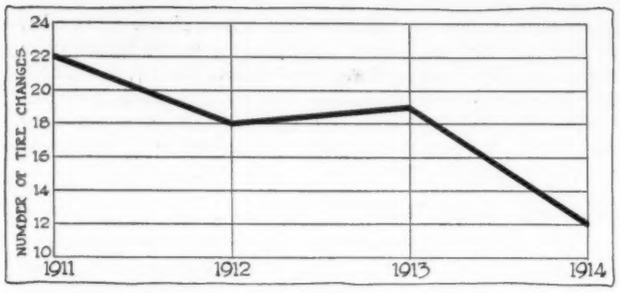


Chart showing the increasing durability of tires in the 500-mile race as determined by the number of tire changes made by the three leading cars for the years of 1911, 1912, 1913 and 1914

speed motor and in the ordinary touring car motor of today, gasoline which issues from the jet in the form of a liquid spray has time to mingle with the air and form a good homogeneous gas while it is passing through the intake passages and being compressed in the cylinder, but that above certain speeds there is not a sufficiently long period from the time the gasoline emerges from the jet to the moment it is fired. Thus very delicate sorts of carbureters which divide the gasoline with almost molecular fineness are able to improve the power by increasing the amount of gasoline which can be burnt in the motor. With gasoline subdivided insufficiently quite a measurable proportion can, under certain circumstances, be either not burnt at all and passed to the exhaust as unexploded vapor, or be burnt inefficiently after the exhaust valve has opened.

It would be possible to go on at great length elaborating the things which have to be considered in building a racing machine, but enough has been said to indicate the immense amount of time, brain effort and labor which goes to the winning of a race, quite apart from the skill and experience of the driver, who often is no engineer, and depends upon others to provide the machine which his daring can steer to victory.

Position of the Six

This year there will be very few six-cylinder cars in the great event. Though a six won the first 500-mile contest in 1911, and still holds the speedway record for an American-built car, four cylinders have usually proved best for racing; more especially, perhaps, as the allowable piston displacement has been restricted. Vibration, which is the bugbear of the four-cylinder, high-efficiency touring car, does not matter within reasonable limits on a racing machine, and also the use of excessively light, albeit costly, pistons and connecting rods reduces the characteristic vibration of the four to something very small indeed. In a six the greater number of pistons means more wall friction, the greater number of crankshaft bearings also tends to cut down the mechanical efficiency of the motor and the weight is usually greater than that of an equal sized four, despite the lighter flywheel. Lubrication is easier in a four and the carburetion of a six is so difficult a problem that two carbureters have been used on most racing machines of this type. Incidentally two carbureters are not uncommon on four-cylinder cars for high speed work, as was explained in the recent series of articles in THE AUTOMOBILE by S. Gerster, who discussed the mechanics of high speed motor design in accurate calculations.

Sixes Scarce for 1915

The table shows the positions taken by six-cylinder cars in previous 500-mile races at Indianapolis and the Grant's Sunbeam which took seventh place last year will be competing again, and its sister vehicle will be beside it with Limberg at the wheel. So far as is known at the time of writing, these will be the only six-cylinder cars in the race, so it will be especially interesting to see how they perform.

Chassis Keeps Pace with Motor

Lightness and Greater Durability Due to Advance in Manufacture

By J. Edward Schipper

CHASSIS development, so far as the racing cars designed for speedway work are concerned, has been proceeding along well-defined lines during the last four years. As a result of this several marked trends may be noted which almost parallel the developments of passenger cars. As may be expected, the cutting of piston displacements from 600 cubic inches to one-half that quantity is sure to cause some definite relative alterations in the design of the chassis. The small, high-speed, light-weight motor, designed to produce the most efficiency from the smallest possible piston displacement, is characteristic of the entire car. Therefore, it is not surprising that we find such factors as wheelbase dropping steadily at the same time. The winner of the Indianapolis sweepstakes in 1911 drove a car with a wheelbase of 116 inches. In 1912 the winner had a 110-inch wheelbase; in 1913, 108, and in 1914, 104. That this trend is almost sure to be continued is evidenced by the number of cars in the race this year, which are of shorter wheelbase than last year's winner.

Special Materials Reduce Weight

With a smaller motor, a shorter wheelbase and a general tendency all along the line towards lightness, it is not surprising that the well-defined trends towards lighter materials of greater strength per unit of sectional area should be marked. The wheelbases which, when taken in connection with the motor, are a positive indication of at least the general features of design, are not only less for the cars which happen to cross the line before their competitors, but are also less for the other cars in the races. That this development is noticeable throughout the entire past 4 years is brought out by the fact that while the car which ran second in 1911 had a wheelbase of 124 inches, the car which finished second best in 1914 was the little 3-liter Peugeot with a wheelbase of approximately 25 per cent. less. Again, the car which finished second in 1912 was 17 inches shorter than the 1911 second. The car which finished second in 1913 was 5 inches shorter than the 1912 second best car. In 1914 the first and third cars had wheelbases of 104 inches, which was the first time that cars of this length were used in an Indianapolis race.

Lightness Aids Tire Durability

One of the natural conclusions to be drawn from the fact that the cars are generally lighter and shorter is that tires would suffer less for this reason. While it has always been stated that the driver and his methods have as much to do with the life of the tires in a contest of this kind as anything else, nevertheless, omitting the personal factor for the time being, the number of tire changes should gradually become less as the weights decrease. It is true that average speeds have become higher, and hence, if the weight were neglected, the tire changes would show an increase. However, in spite of the increase in speeds tire life has held its own.

In the 1911 race the number of tire changes for the first three cars to finish was twenty-two. In 1912 it was eighteen. In 1913 it was nineteen and in 1914 it was twelve. More than once it has been the stopping for tires which has lost

the race for one of the competitors, and the fact that in the last four years the number of tire changes for the first three cars has dropped almost 50 per cent. shows that this relative lightness, which probably in actual pounds would not show up to a very large extent, has had its influence.

Wire Wheel and Cord Tire Run Cool

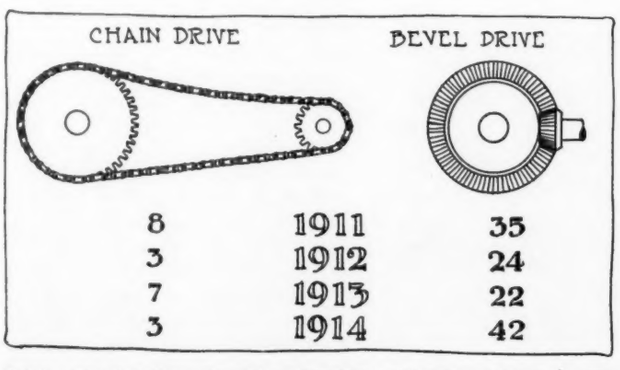
The credit for the good tire showing has often been given by authorities to the use of cord tires and to the use of wire wheels. Undoubtedly these two factors have had great influence. With the cord tire inflations do not have to be as high as with the fabric type and consequently internal stresses on the tire, due to the great change in temperature after being in use for a short time at the high speeds, are not as great. The shock-absorbing qualities of the tire are no doubt aided by the lower inflation, and the cord construction itself is one which is calculated to give excellent results under the condition of racing temperatures. On the other hand some of the fabric tires have shown up in recent contests to such a remarkable degree that the choice of one or the other type is a mooted point.

The cooling influence of the wire wheel is granted on practically all sides. The conductivity of the all-metal construction is naturally much higher than the wood type, and aided by the blast of air created at the high racing speeds, there is no doubt but what the use of this type of wheel has its influence on the tires. Another great advantage, of course, of the wire wheel is in its quick-detachable feature which permits tire changes to be made constantly at speeds of 30 to 45 seconds per change. The wire wheel is, therefore, a racing desirability because of its promotion of fewer and quicker tire changes. Even in the 1914 race it was estimated that the casings destroyed represented an investment of $14,000, as during this race 138 shoes were used, and many of these were specially constructed at a cost much higher than that of the average tire.

Inflation Pressures Falling

The lesson learned on tire inflations has also been a governing factor in determining the pressure in recent races. In 1911 inflations of 80 pounds were the usual condition. In the race of 1914 the winning Delage had a tire inflation of 4 kilograms per square centimeter, which figures out to be about 57 pounds per square inch. The tires used were 35 by 5 front and 35 by 6 rear. The Sunbeam, driven by Chassagne, had 34 by 4.5 tires inflated to only 65 pounds. Others carried inflations as low as 37 pounds. To realize the final pressures which are in the tires, even though they are inflated to this relatively low pressure at the start of the race, it is only necessary to be close enough to the track to catch the odor of burning rubber, which pervades the air. It is estimated that the tires reach a final pressure of over 100 pounds per square inch. There is no doubt that the cord tire is responsible.

In actual mechanical detail the chassis proper of the car has varied far less than the source of power. There have been very few trends which are of sufficient importance to be significant in design. Perhaps in the use of materials the greatest change may be noted. With the improvement in the art of heat-treating and alloying steels it has been possible to cut down the sizes of some of the parts and give a stronger result with less weight. The use of tubular members has also been a great factor in the development of the racing car.



Chain drive has been dropping while bevel drive has gained steadily

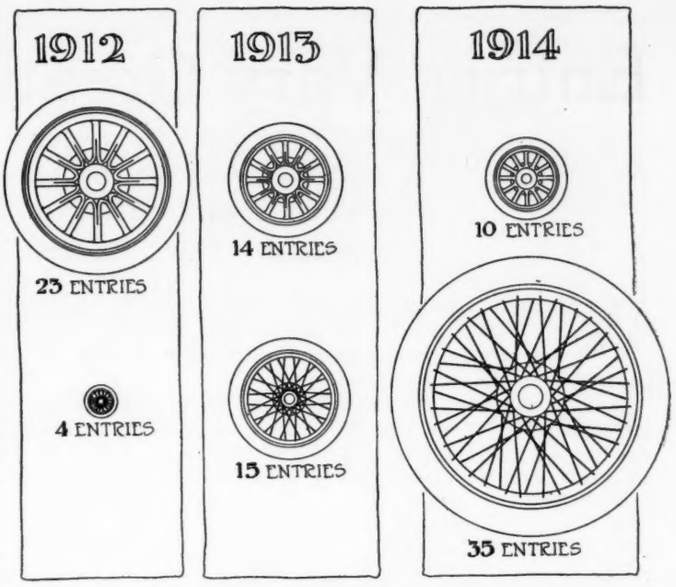


Diagram showing the relative increase in popularity of the detachable wire wheel for racing cars as represented at the Indianapolis race

Specifically the falling off of the chain drive racer is perhaps the most significant feature of chassis design. It is one of the points which show how closely racing and touring practice are affiliated. In the race of 1911 no restriction was placed on the use of chains for driving purposes, but they are now allowed only if covered. In 1911 18.5 per cent. of all the entries had chain drive, in 1912 this had dropped to 11.1, and in 1914 it had fallen off to 6.6.

Cleaning Up the Outside

One of the features which have a great deal more importance than would be evidenced at first sight is the general cleaning up of the exterior lines of the racers. It is probably the competition of the foreign car which has forced American racing car builders into line on this point. When the speed crown was wrested from the Americans in 1913 by a European contender, one of the first reasons assigned to the greater speed of the invading machine was the cleaner lines of the latter. As a result of this the American cars of 1914 were much better appearing jobs than the cars of 1913 and 1912. Greater attention was paid to the entrance and tail lines of the cars than in any previous race in this country. The importance of having a tapering end on the car is also being recognized, and although many disadvantages have been claimed against its use by some of the more conservative drivers it has gained a foothold.

Freak designs and radical departures from standard practice are not as frequent now as they were in the earlier days of racing, when the Vanderbilt was the classic which focused all the eyes of motordom on the Long Island course. As far as the chassis part of the car is concerned it is worked out fairly well along conservative lines, which have proven successful in the touring field. There is not a big variation in fundamental principles between the touring car chassis and that which is suitable for racing.

Entries Vary Greatly in Displacement

Wide Variety from 117 to 299 Cubic Inches Shows Period of Transition in Design —Many Dark Horses in this Year's Race

WHILE the annual crop of dark horses promises to be as large as ever at the Indianapolis Race this year, the clouds have lifted sufficiently for a fairly good perspective of the 1915 entries.

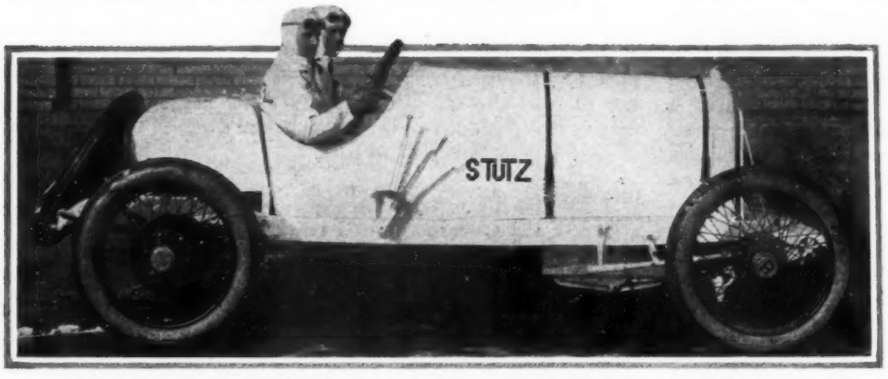
A study of the entry list shows that we are in a transitory stage. The day of the monstrous racing machine has passed and we are now going perhaps to what may be called the other extreme, the entries having a piston displacement as low as 117 cubic inches. On the other hand, we have some of the older cars which have been driven in the last Grand Prix race of France which are exactly similar in design to the Indianapolis Race of last year. It is, therefore, expected that this race will be the greatest event, as far as showing up the respective merits of the light high-speed design and the heavier, more powerful care is concerned, that has ever occurred.

Two Peugeot Types Entered

A good example of the uncertainty which still pervades racing circles as to what is really the ideal car for such a grind as the 500-mile Hoosier event is in the Peugeot cars. There are three of these entered, one of which is the 4.5 liter car driven by Boillot in the last Grand Prix race of France. The cylinder dimensions of this car are 92 millimeters by 169 millimeters, or 3.62 by 6.64 inches, giving a piston displacement of 274 cubic inches. The motor design is similar to the car which was in last year's event and this year Dario Resta will pilot it.

The other two Peugeot entries are of the new school of high-speed engine design. They are what are known as 3-liter cars in France. The dimensions are 78 by 156 millimeters or 3.07 by 6.13 inches. The piston displacement is 183 cubic inches. These cars are almost exactly the same as that driven by Duray last year. This car finished second and was the sensation of the race, as no one thought that a car with such a small piston displacement had much chance with the racing machines which were designed to fall just beneath the 300-cubic inch displacement limit. The two cars this year are to be driven by George Babcock and Caleb Bragg.

The performance of the two little Peugeots will be watched with great interest this year. The motor develops 92 horsepower at 2,870 r.p.m. In other words, 1 horsepower is developed for every 2 cubic inches of cylinder volume. Great lightness and compactness are features which have been made pre-eminent points throughout the design. The cylinders are the shortest possible block castings, having four valves to the cylinder mounted in the head and inclined 30 degrees to the vertical. The camshafts are overhead in order to cut down weight due to long rods in the operating mechanism. The pistons are machined out of solid B. N. D. steel, which is used largely throughout the car in such places as the connecting-rods, gearbox, shafts, axle and driveshaft. The car will probably be geared 2 to 1 and will have a total weight with oil and water of about 1,760 pounds.

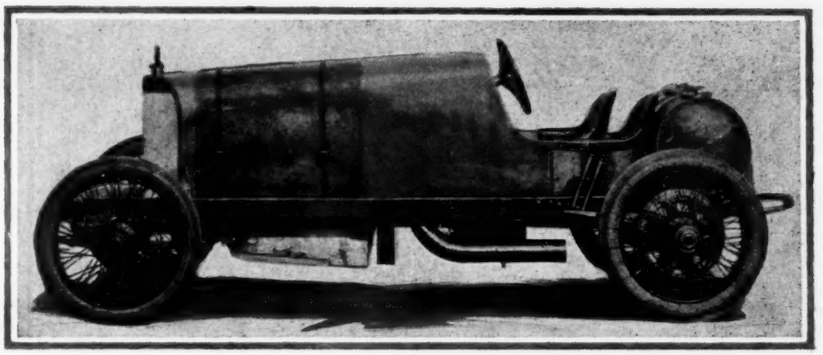


Stutz side view, one of the three special racing machines entered by this company

Mercedes driven by De Palma, an example of the attention which is paid to wind resistance

Sunbeam Sixes and Fours

The Sunbeams are also in two kinds; both old and new. There are two six-cylinder Sunbeams which are the old models which have made a long racing campaign during the last year and one half. These have been purchased by the Fortuna Racing Team, Inc., from William Ziegler, Jr., and entered in the Indianapolis Race in a form which is somewhat modified from what they were originally. In addition, there are two four-cylinder Sunbeams which are new as compared with the others, having been built for the last French Grand Prix at Lyons. The sixes have 3 by 6 motors giving a piston displacement of 278 cubic inches. They are said to be capable of 110 miles per hour geared 2.75 to 1. In rebuilding these cars they have been fitted with two carbureters each, and are now capable of turning



Two views of Porter-Knight, the sleeve-valve racing machine which is characterized by an extremely narrow body

up to 3,000 r.p.m. An auxiliary cooling system for the valves has been put in with a separate outlet to the radiator for the purpose of keeping the valveheads cool. Spicer universal joints have also been added in place of the original design.

The new four-cylinder Sunbeams have 3.7 by 6.2 inch motors with piston displacement of 271 cubic inches. They have two camshafts arranged directly over the valves which are located in the cylinder head. To each cylinder there are four valves, giving 16 valves in all, and the camshafts are driven by a train of spur gears contained in a case at the front end of the cylinder blocks. The crankshaft runs on ball bearings and is a built-up design in two halves. The Sunbeam-type piston with perforated skirts is used, the material of which they are made being steel. Unlike many other racing cars a differential is used and this car, like the six, is said to have a straight-away speed of 110 miles per hour.

Bugatti Piston Displacement Decreased

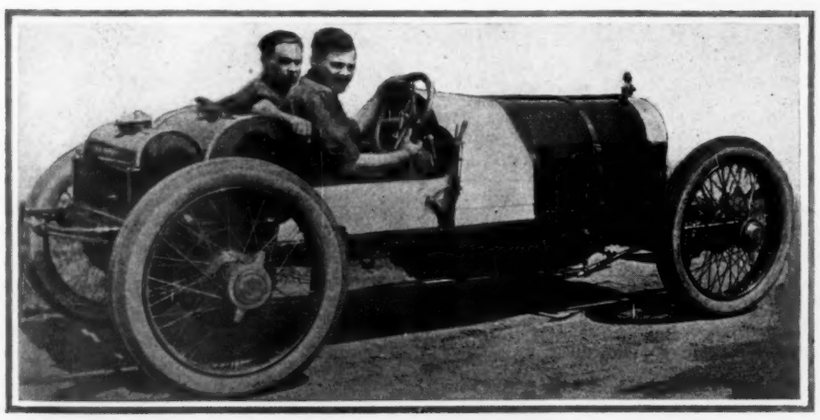
Barney Oldfield's Bugatti is not the same car as was at Indianapolis last year. It has a smaller displacement and differs from practically every other entry in having chain drive. Last year's car had 305 cubic inches piston displacement and hence is oversized for the Indianapolis Race. The White factory has built a new crankshaft with a 3-16 shorter crank throw, bringing the motor to 298 cubic inches piston displacement. A new front axle and body has also been built for the car. With the remodeled specifications, the bore of this motor is now 4 inches and the stroke 5.937. The wheelbase is 111 inches, and the tires 32 by 4.5. A dry plate disk clutch is used and a four-speed gearset. It is estimated that the car will weigh in the neighborhood of 1,800 pounds when ready for the race. One of the features of this car which make it different from standard design is that the tread is different in front and rear. The front tread is 51 inches and the rear 49 by 5 inches.

This car is one in which multiple valves are used. There are twelve of these overhead, operated by an inclosed valve gear. The motor throughout is a very accessible job and one which is notable for the fineness of its material. The entire cylinder head is detachable.

Duesenberg Has Two-Bearing Crankshaft

Three Duesenbergs are entered this year. These are all of similar design. The motor has the predominating racing characteristic of having its valves in the head. It is a four-cylinder block design, with very close coupled cylinders to produce a short motor and at the same time allow ample water space between the units. The motor is 3 63-64 inches bore by 6-inch stroke giving a piston displacement just under the limit of 299 cubic inches. The crankshaft is carried on two bearings and has a diameter of 2.25 inches. It is made of chrome-nickel steel and the bearing lengths are respectively 4 and 4.5 inches for the front and rear. Connecting-rods are also of chrome-nickel steel giving maximum strength with maximum lightness. To maintain the same strength throughout, the lower end bearing caps are held in place by four 7-16-inch vanadium bolts.

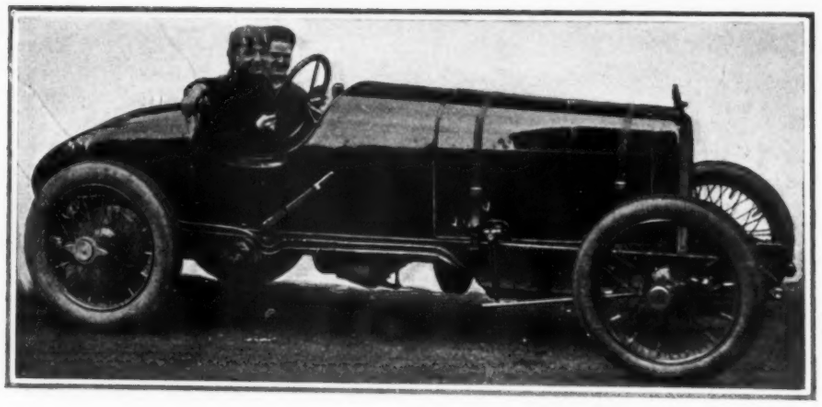
Standard tread of 56 inches will be used on the racing cars and the wheels will be 33 by 4.5 front and 33 by 5 rear. The gearset is mounted directly on the rear axle. When in racing trim, the equipment consists of quick detachable large hub-type wire wheels, with Timken bearings. The gearbox has New Departure ball bearings. This car will use left drive and will have semi-elliptic springs all around.

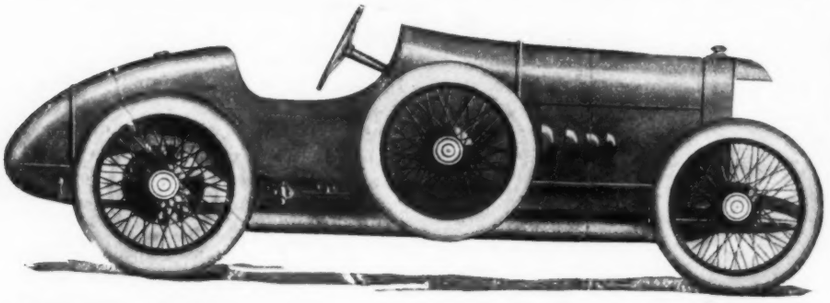


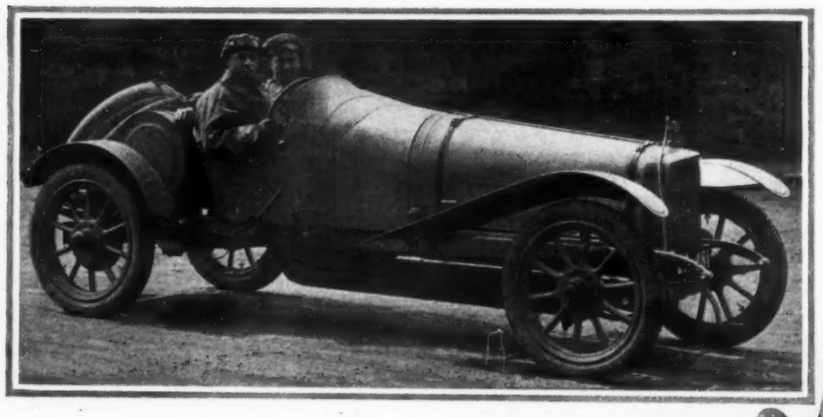
The Emden, a new car for this year, built especially for the speed grind

Special Knight Cars

Three cars which will be followed with unusual interest are the Porter-Knight entries. As described in THE AUTOMOBILE for May 6, these are specially designed Knight cars intended entirely for racing. The changes made from ordinary Knight practice in these designs include the use of two eccentric shafts instead of one; the use of an auxiliary exhaust port close to the lower end of the valve sleeve; large port areas and a shorter valve sleeve stroke. It is stated that by mak-







Top—One of the three new Mercer cars especially designed for the Indianapolis race

Upper Middle—The Mulford special, a car built and driven by the racing driver

Lower Middle—Side view of the Duesenberg which has been re-designed for this year's race

Bottom—One of the new four-cylinder Sunbeams entered for this year

Right—Front view of the four-cylinder Sunbeam in racing trim

ing these changes it is possible to run these motors up to as high as 5,000 r.p.m. in the testing room. The horsepower curve shows that with the new features of design, 122-horsepower is developed at 3,950 r.p.m. In a word, this is a racing creation weighing 1,910 pounds with a four-cylinder 3.75 by 6.125 motor having a piston displacement of 270 cubic inches or well under the 300 limit for Indianapolis.

The racing chassis is built with a 110-inch wheelbase, 56-inch tread, 32 by 4 front tires and 33 by 4.5 rear. While no attempt has been made to adhere to what are popularly known as stream lines, wind resistance has been cut down by the use of an extremely narrow body. Weight reduction has been accomplished by the use of chrome-vanadium steel, air-hardened steel and magnalium, a magnesium-aluminum alloy. In addition to this the use of hollow parts has also resulted in a saving. The propeller shaft is one example of this. An unusual feature is the use of a four-speed gearbox which weighs but 90 pounds including the brake drum, which is mounted on the rear. In a word it has been designed throughout with speed and lightness as the primary ideas. The speed is gained by the use of the high-powered motor and narrow body and the lightness by the use of extremely fine material.

New Mercers Entered

Great interest attaches to the Mercer entries this year, because of the fact that in last year's race the new designed Mercers were eliminated in the trials and the only ones to compete were the older jobs driven by Wishart and Bragg. The Mercer for this year has a smaller bore and longer stroke than that of 1914, these dimensions being 3.75 by 6.75. All three cars are the same, having piston displacement of 298 cubic inches, bringing them just below the 300 limit which has been set by the race authorities.

It was Eddy Pullen who suffered the disappointment last year of being elimi-

nated in the trial event and he has been selected to drive one of the three entries along with Ruckstell and Nikrent. These are all shaft-driven cars having gear ratios of 3.1 to 1 with 32 by 4 1-2 tires of Goodrich Silvertown cord make. The wheels are Rudge-Whitworth wire and the cars are equipped with Hartford shock absorbers, Bosch magnetos and Zenith carbureter.

Maxwells Have Offset Valves

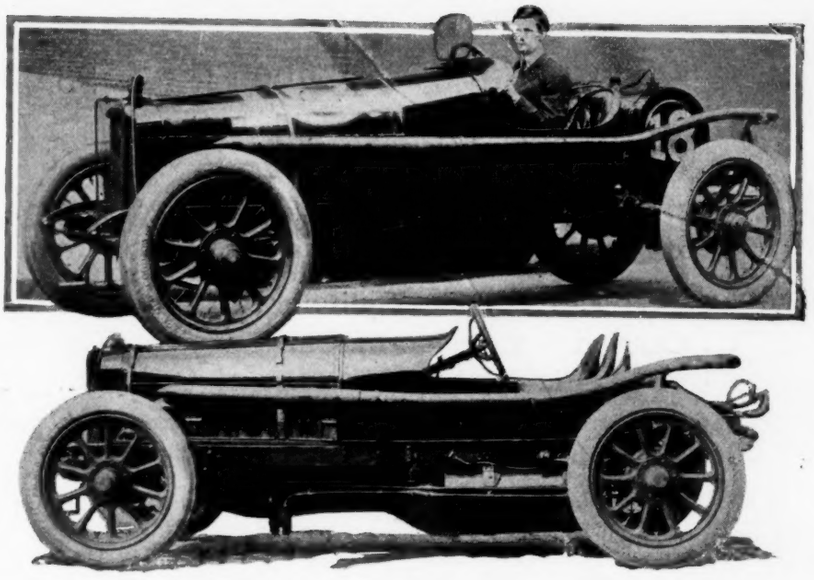
The Maxwell cars have been fully described in THE AUTOMOBILE for March 25. Three of these are entered to be driven by Carlson, Rickenbacher and one undecided. Generally speaking, they are similar to the Maxwell racers which have been campaigning about the country this year but are cut down to bring them within the 300-cubic inch limit. They are now 3.75 by 6.75 inches, giving a piston displacement of 298.2 cubic inches. The motors are off-set overhead valve design with overhead camshafts. The crankshaft is a counterbalanced design made in two halves, the counterbalance weights displacing the flywheel. The crankshaft is carried on three ball bearings. The cylinders are block cast with a detachable head and the intake and exhaust passages are on opposite sides of the motor. The cars weigh but 2,075 pounds, which is largely due to a liberal use of aluminum alloy. An unusual feature is the use of a windshield to reduce eye strain on the drivers.

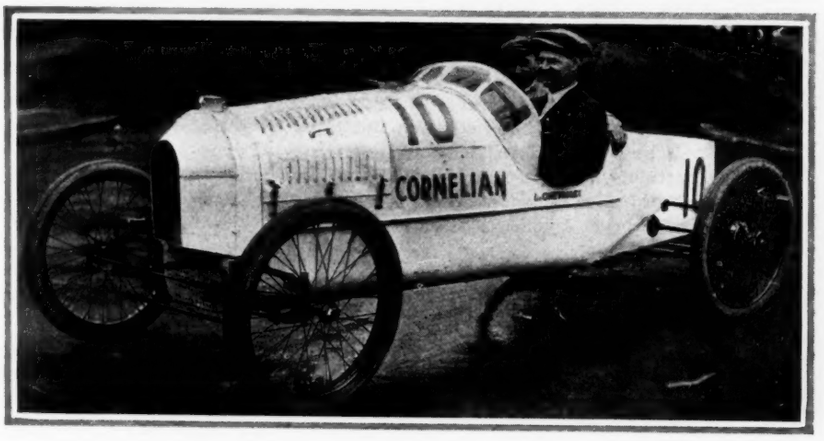
The Harroun special is practically identical with the Maxwells. It was built in the same shop and is practically the same in exterior appearance.

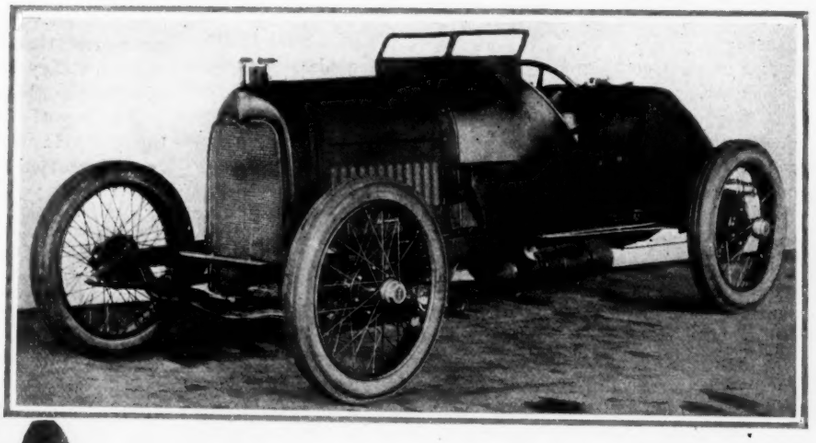
Mulford Uses Offset Crankshaft

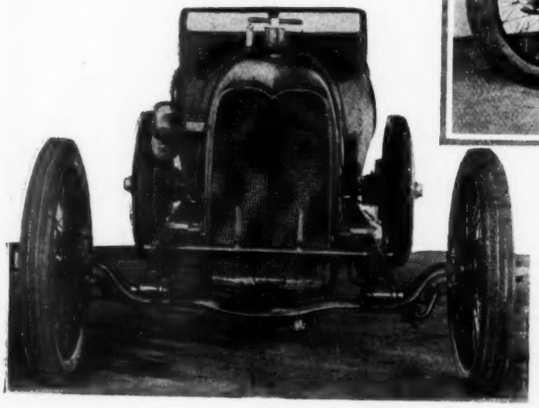
The Mulford special which was designed by Ralph Mulford who will drive it has a four-cylinder motor with 3 11-16 bore and 7-inch stroke, giving a displacement of 299 cubic inches. The unusual feature of the motor is that it is said to be the only one ever built with an offset crankshaft and having two camshafts and only three timing gears. Special attention has been paid to the oiling and

(*Continued on page* 919)









Top—Six-cylinder Sunbeam driven by Limberg with tank mounted behind seat

Upper Middle—Six-cylinder Sunbeam to be driven by Harry Grant with tank mounted at rear of frame

Lower Middle—Cornelian, the smallest car of the race, with 117 cubic inches displacement

Bottom—Maxwell, the only car in the race to be equipped with a windshield

Left—Front view of Maxwell. Note small area of wind-resisting surface

$1,250	$2,000	$3,000	$3,000
50	54	57	73

How Many Cylinders?

What Is Ideal Size for Cylinder? Comparison of Motor Size with Passengers Carried and Price of Car Suggests That Twelve Has Legitimate Field—A New Way of Comparing Eights and Sixes

By A. Ludlow Clayden

IT has been suggested several times that there is an ideal size for the individual cylinders of an automobile engine. Some have chosen definite proportions such as 3 inches by 5 inches or 4 inches by 6 inches, as being ideal bores and strokes, but such choice appears to have been based upon particular experiences. By making some debatable assumptions to start with it seems possible to attack this subject from a new angle; to consider it on a broader basis than has been done before. The writer realizes that there is much in the following that is subject for discussion but examination of collected data and the modern trend in multiplicity of cylinders does certainly suggest that there are good reasons for the idea that *all things considered* there is a definite maximum size of cylinder beyond which it does not pay to go.

What Is Ideal Cylinder Volume?

Turning to collected data to provide us with a starting point for making out a case for one or another type of motor, let us take the tables in THE AUTOMOBILE of December 31, 1914, and extract the cylinder displacement per passenger for the different classes of car therein specified. We then find that the average piston displacement per passenger, neglecting roadster and closed body types and considering only touring cars, is:

1. For cars costing less than $1,250, 50 cubic inches per passenger.
2. For cars costing less than $2,000, 54 cubic inches per passenger.
3. For cars costing less than $3,000, 57 cubic inches per passenger.
4. For cars costing more than $3,000, 73 cubic inches per passenger.

These are only rough round figure averages, but they serve to indicate the general trend.

Now there are two important things which vary in these cars, the total cylinder volume and the number of passengers carried; so if we assume that there ought to be a definite number of cubic inches of motor for each passenger the size of the motor varies according to whether the body is designed for five, six or seven passengers. In each class we find bodies of these three capacities so the clearest way to examine the problem along this line is to tabulate car capacity and motor size together with possible number of cylinders to provide this total displacement, as is done at the foot of this page.

Of course the cars in class 1 are mostly fours, those in class 2 are practically half and half fours and sixes; and the eight here makes its appearance. Class 3 is principally sixes but has a fair sprinkling of fours, and class 4 contains no eights and only one or two fours.

Let us see what are the respective cylinder sizes. For a five-passenger four-cylinder touring car in class 1 we want 250 cubic inches or 62 cubic inches in each single cylinder.

In Class 2 we want 270 cubic inches for five seats and 378 for seven passengers.

Supposing the smaller motor to be a four, we get a size of 67 cubic inches per cylinder, and if the seven-passenger is supposed to be a six we get 63 cubic inches or practically the same sized cylinder as that of the four-cylinder motor used in Class 1.

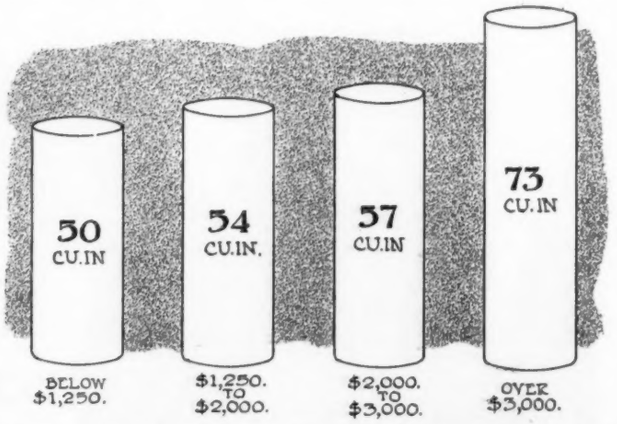
The average passenger capacity of Class 3 is just six passengers, as fives and sevens balance, so the motor needs to be of 342 cubic inches. For a five-passenger six, we should find the size per cylinder was only 47 cubic inches and 71 cubic inches for a five-passenger four, while seven passengers would call for a six-cylinder motor with cylinders of 66 cubic inches each, or a four-cylinder with 99 cubic inch cylinders.

Coming to Class 4, which includes all the really high-priced cars we find a sudden leap to 511 cubic inches for seven passengers, or 85 cubic inches per cylinder of a six-cylinder motor. It is easy to see that a four-cylinder for this load and to keep the same proportion would require huge dimensions since a capacity of 128 cubic inches per cylinder calls for a gigantic bore and stroke.

Advantages of Moderate Size

Again let it be emphasized that these figures are only expressed in round numbers and are far from decimally accurate, but they certainly suggest that the higher the price of the car the greater the power demanded per unit of load.

The buyer of a high-priced car expects more than this, though. He wants greater flexibility, top speed power that is, and greater smoothness and quietness. It needs no calcu-

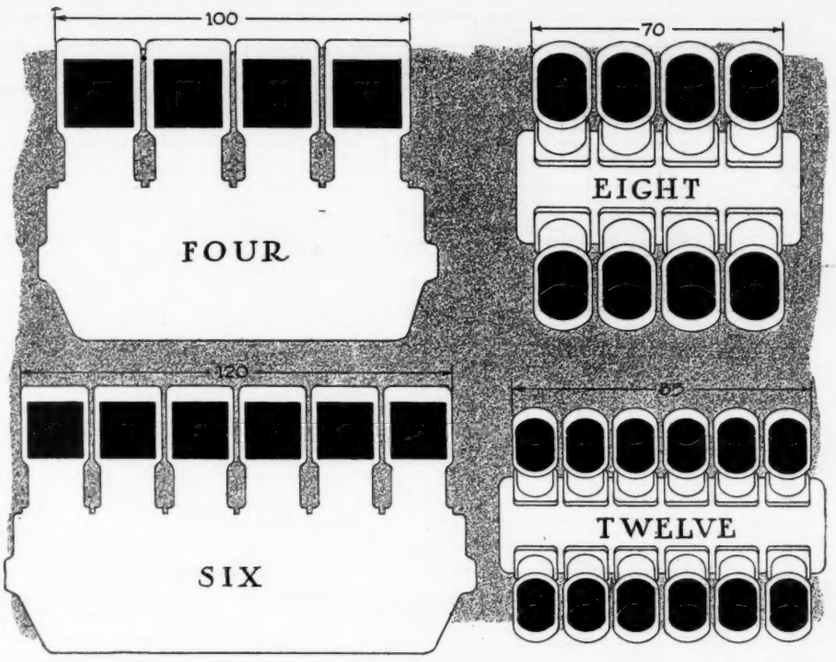


Average piston displacement per passenger of touring cars in four price classes

lations then to see why the four-cylinder motor is dead so far as large cars are concerned, for the stresses set up by reciprocating parts vary with *multiples* of their dimensions.

The European engineer, accustomed to light, high-speed, four-cylinder motors, has for years regarded this type as final, at least within the limits of ordinary mechanical finality. With the eight-cylinder motor hardly any experiment has been made in Europe, and in recent years no manufacturer whatever has applied the principles of modern high-speed motor construction to any engine with more than six cylinders.

As recently as 5 years ago there were made many attempts in Europe, to produce small sixes of proportions round about 3 by 4.5-inch bore and stroke, but they were mostly failures and the European makers generally turned to the refinement of the high-speed four; that is to say they increased the power obtainable from small fours instead of retaining the same power per cubic inch of displacement and adding cylinders.



Relative sizes of four, six, eight and twelve-cylinder motors having the same total piston displacement

Meanwhile, in America manufacturers were likewise not satisfied with the somewhat vibratory fours which were then the rule, but instead of following the European lead they struck out a line for themselves and developed the inexpensive six with a large capacity and not a very high power per unit of volume. Taxation by horsepower practically prevented the use of large motors abroad, and the road conditions suit a small, light car better than a large and heavy one, which is the exact opposite of the American case.

Yet it is not solely on account of taxation that it has become an axiom in Europe that one cannot make a satisfactory job of a four-cylinder motor which greatly exceeds 4 liters or just about 250 cubic inches in capacity. Proportions of stroke and bore have little to do with the matter, since the long-stroke motor needs a higher piston speed and multiplies stresses that way.

A car with a motor of this size should carry five passengers over good European roads at a maximum of about 65 miles per hour and climb a grade of about 7 to 8 per cent. on high gear. This would give insufficient ability for ploughing through sandy roads and taking small grades thereon without much gear shifting to suit the conditions of this country, so we have the alternatives of adding to the cylinders or dropping the gear ratio; which means that the speed capacity is impaired.

Effect of Cylinder Size on Number

Just for a moment let us suppose that the European idea as to the useful limit of size per cylinder is about correct and apply this size to the classes of cars dealt with above. This shows us at once that the limiting size just suits a five-passenger car in class 1, as it gives the requisite size of motor to apportion 50 cubic inches to each passenger. In classes 2 and 3 the four is a little overlarge and the six comes well within the limit, but when we get to class four the cylinder size for six cylinders and seven passengers is well outside the limit.

Now, it should be added that this European idea is distinctly on the high side as compared with recent French and British average practice, for in this the most popular kind of large four has cylinders of only 52 cubic inches, 10 cubic inches smaller than the 62 cubic inch cylinders which make a 4 liter four.

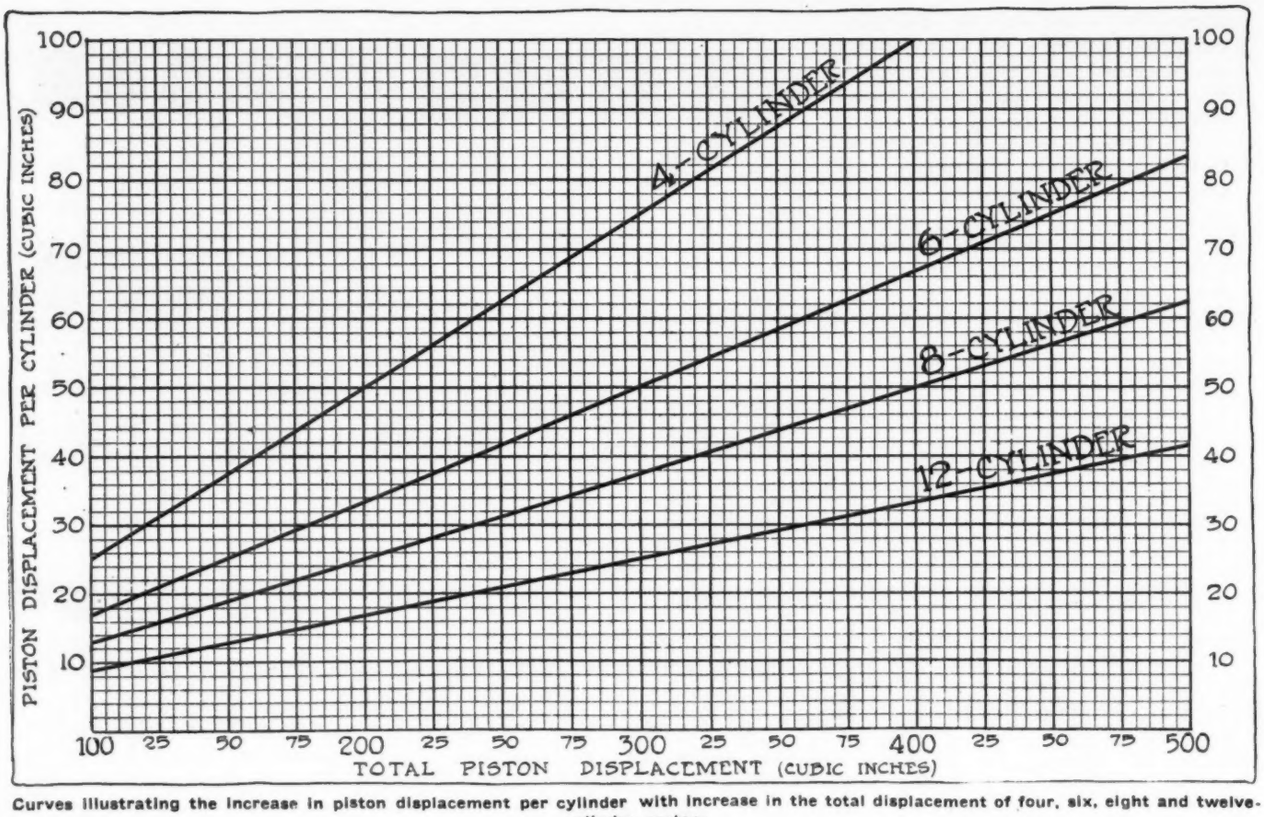
Effect Of High Speed

There is no doubt at all that the smoothest and highest efficiency motors made as an ordinary European manufacturing proposition are between 40 and 50 cubic inches capacity per cylinder. There are many larger than this, but experience shows that it means careful work to balance pistons and connecting-rods, and expensive heavy crankshafts if the much desired smoothness is to be obtained from the larger engines.

Here let it be said that this argument does not imply that the high-speed four has no place on American roads. Far from it in fact; for when a car of limited seating capacity and intrinsically light weight is wanted and this is the

Comparison of Cylinder Volumes Required for Cars of Different Price Classification and Passenger Capacity

	Class 1 to—$1,250			Class 2 to—$2,000			Class 3 to—$3,000			Class 4 over—$3,000		
Number of Passengers	5	6	7	5	6	7	5	6	7	5	6	7
Total Cylinder Volume in cubic inches	250	300	350	270	324	378	285	342	399	365	438	511
Volume per cylinder for 4 cylinders	62	75	87	67	81	94	71	85	100	91	109	128
Volume per cylinder for 6 cylinders	42	50	58	45	54	63	47	57	66	61	73	85
Volume per cylinder for 8 cylinders	31	37	44	34	40	47	36	43	50	46	55	64
Volume per cylinder for 12 cylinders	21	25	29	22	27	31	24	29	33	30	36	43



Curves illustrating the increase in piston displacement per cylinder with increase in the total displacement of four, six, eight and twelve-cylinder motors

cheapest sort of car to run; then the high-speed motor will give a better speed capacity to the car and better top-speed performance. Yet again, higher speed and lower gearing means smaller impulses and less torque variation, which also means smoothness in running, especially in running slowly.

Six Cylinders Costly

At first all went well with the six-cylinder development in this country, but when manufacturers sought to improve the quietness and smoothness of their motors they soon found that a refined six was a most expensive sort of engine to build. Also it is a heavy type of motor unless a great deal of care is taken in its design and manufacture, because its length calls for immense strength to maintain rigidity. The larger the cylinder bore the more difficult does it become to make the crankshaft and crankcase of absolute rigidity, and if they are not rigid there will be unpleasing vibration at certain speeds.

Yet again, although the torque of the six is a great deal better than that of a four, the large engines, which have become the rule are run at such slow speeds on high gear that the individual impulse from each cylinder on say a 4 by 6 motor, can be felt very distinctly. If we increase the number of cylinders, this effect can be avoided, the reciprocating parts can become lighter, the stresses can be reduced, the amount of metal needed to maintain rigidity is less and the cost is probably reduced a little, it is not increased in any case.

Are Eight Sufficient?

So if we argue the advantages of small cylinders the only way to apply them to the big, heavy car is to use more than four and even more than six. There is no need to go into the pros and cons of six versus eight as a manufacturing proposition, or to discuss the advantages of short crankshafts, etc., for that has been done so many times already, but if we apply the limited cylinder theory to the big cars we shall find that even eight cylinders are hardly enough. Take the seven-passenger car of class 4, and practically all cars in this class *are* seven seated, and it is observable that the total capacity called for is 511 cubic inches.

With six cylinders we are above 60 cubic inches per cylinder by no less than 25 cubic inches or nearly 50 per cent. With eight cylinders we are still outside as the value per cylinder becomes nearly 64, but with twelve cylinders we come well inside with 42.5 cubic inches. Now this size is almost exactly that of one cylinder of a 3-liter (183-cubic inch) four-cylinder motor, and of all sizes made in Europe this is the most popular and has given the very best all round results.

Twelve-Cylinder Rational

Thus it is rational to anticipate not only the appearance of twelve-cylinder motors for driving large cars, but rational to try to develop them. Take for example the weak spot of the six-cylinder motor which is, of course, the crankshaft. It is now well-known that the eight-cylinder V motor is extremely easy on the crankpin bushings and that the maximum bending moment on the center bearing of the crank is also less than double that due to either set of four, which make up the engine, by a considerable amount, while it is hugely less than the stress which would be present in a four of equal total capacity.

Similarly with the twelve, as compared to the six, the crankshaft bending moment is very small by comparison with the cylinder volume of the engine and the stresses on the lower end connecting-rod bearings are also very light.

Further, although the torque of the eight is so good that even a sixteen-cylinder motor could hardly better it within the limits of human perception, it still does possess that undesirable transverse vibration when the cylinders are set at 90 degrees and compound vibrations if any other angle is chosen. These vibrations are small and not of much ac-

count as they are less in amplitude than the usual torsional and flexure vibrations found in the average six, but the twelve has no vibrations whatever either transverse or compound, whether the angle between the cylinder center lines be 90 or 60 or any other number of degrees. Because either of the two blocks of six which make up a V twelve are in themselves balanced quite perfectly. We are left, in considering the twelve, with only one possibility, and this is the chance of torsional crankshaft deformation.

It is easy to see that the order of firing might have a considerable effect upon this point, but remembering that we can get all the power needed for the very largest car with cylinders of quite small size individually, it is hardly to be expected that torsional oscillations would prove difficult to eliminate. It means that the shaft must be stiffer.

Twelve Can Be Narrow Motor

Just here has been mentioned without comment another advantage of twelve cylinders as compared with eight, for large motors, this being the ability to set them at a narrow angle and so do away with the great width which might be a trouble on a large eight. On the very big car one needs a hood of reasonable length to prevent the appearance becoming squat, and with cylinders of 3 or 3.5 inches diameter the length necessary would be imperceptibly more if any more, than that required for an eight of equivalent total volume. Width however is a very different matter, for the twelve would be many inches narrower.

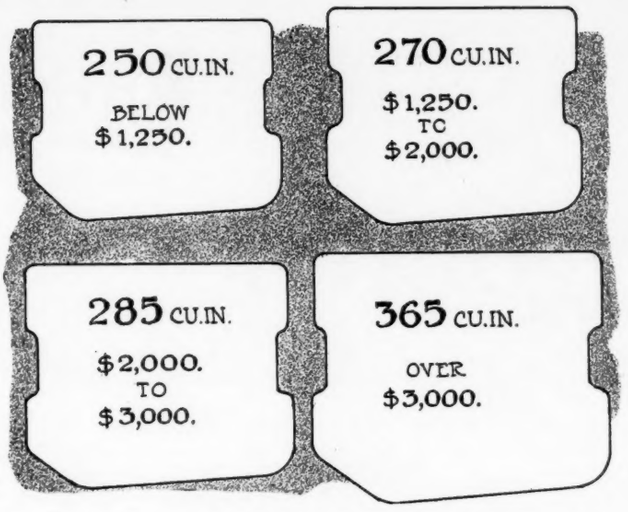
Thus far the conclusion is that as long as very high power is required for large cars the twelve-cylinder is a perfectly rational development along the sound engineering lines of common sense and experience, and there is also room for eights, sixes and fours, according to the power required. This might be qualified by saying that it would seem reasonable also to anticipate a good deal of close running on pro and con between eights and sixes, the final result being to eliminate one or the other.

Now it is time to turn to the other side of the picture and examine the disadvantages of the twelve. There is the obvious one of complexity and the thought of twenty-four push rods and twenty-four valves is, at first, certainly alarming. Let it not be forgotten, however that the kind of man who buys a car of 80 or 90 brake horsepower is not likely to allow himself to trouble about such things so long as he obtains satisfaction while the adjustments are correct. Nor is the task of valve grinding double that of the six, because the valves are so much smaller, so the cost of a clean and tune up in the repair shop ought not to be much more.

Twelve Costly To Build

From the manufacturer's viewpoint the case is less easy to argue, and there is hardly any doubt that the cost will be greater than that of either a six or an eight of equal total volume. It might not be so very much greater but it is difficult to imagine that it could be the same. Of course, if we accept the contention that the eight is cheaper than the six of equal size, then we ought to take the manufacturing problem as twelve versus eight and cut out the six. Doing this we find a certainly more costly crankshaft and crankcase, 50 per cent. more cylinder bores, 50 per cent. more valves, push rods, cams, etc. Only a trifle is saved by the smaller size of these parts so a fair guess at the difference between six and eight would be from 30 to 40 per cent. in favor of the eight. It does not follow, by any means that this precludes the use of twelves, however, because there are still plenty of people willing to pay for a large and expensive car.

Where this question of manufacturing cost does come in is when we consider the possibility of a cheap twelve with minute cylinders. Suppose we started to lay out a twelve-cylinder motor to suit the power demanded by class 2, for example; that is to have a capacity per passenger of 54



Comparison of average total piston displacement of touring cars in the four price classes

cubic inches. Assume, if you like, a six-passenger car giving a total of 324 cubic inches. This means 45 cubic inches per cylinder for an eight or just about the convenient size, but the twelve would have cylinders of only 27 cubic inches capacity. This we could get with a bore and stroke 2 7-8 by 4 inches or 3 by 3 7-8 inches roughly, which suggests that the valve parts might easily become inconveniently small and the clearances inside the crankcase likewise troublesome. This is only theory, and experience with a type of motor as yet to be created might very possibly cause the theory to be confounded on this point. It is, however, obvious enough that a tiny twelve of this character would cost considerably more to build than an eight 3 3-8 by 5 inches which would give about the same total capacity.

If we assume that a car in class 2 is sufficiently provided with power when the motor is chosen on a five-passenger basis, or with a total volume of 270 cubic inches, the case for the eight becomes greatly strengthened.

Thus it is not to be expected that the introduction of a few twelves will be followed by a boom in that type of motor. It has been the purpose of this article to examine the case for different numbers of cylinders and it has been shown that there is at least one good engineering reason for the appearance of the eight, based on experience of economic limits of individual cylinder size. It also shows that the same reasoning makes an equally good case for the twelve in large sizes, but for the minute twelve or the minute eight there seems no good reason whatever from an engineering point of view.

Amount of Power Needed

While on this subject it is worth touching upon the amount of power obtainable from these different kinds of motor. Within limits of practical manufacture it is usual to find 1 horsepower delivered by each 6 cubic inches of cylinder volume, more or less irrespective of number or size of cylinders. On a good many cheap motors the power is not so great as this and on a sprinkling of others it is greater, but the figure is a fair average. Applying this to the class arrangement we find that cars in class 1 have roughly 8 horsepower per passenger; class 2 has nearly a horsepower more; class 3 a little more still and class 4 no less than 12 horsepower per person. Of course this classification is open to criticism, because the cars are heavier and as the price goes up there is more *car* per passenger as well as more power, but the figures may be useful as indicating roughly what the purchaser expects to get for his money.

The Rostrum

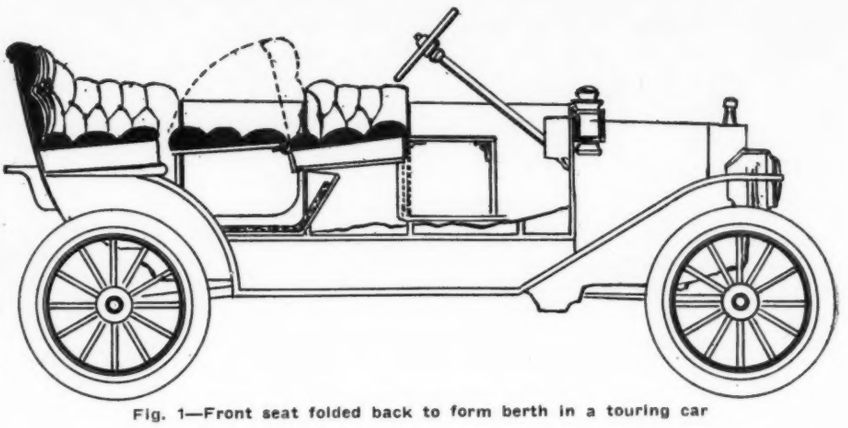


Fig. 1—Front seat folded back to form berth in a touring car

Highest Speed Not Greatest Power

EDITOR THE AUTOMOBILE:—I have a Henderson four-cylinder motorcycle having a motor of 2 5-8 inches by 3 inches bore and stroke which I believe is out of balance. When I purchased the machine new it was geared 4 to 1 and would run very well up to its maximum speed of about 65 miles per hour. This speed would correspond to a motor speed of about 3,120 r.p.m. As the machine would not climb hills very well, I geared it down to 4 1-2 to 1. With this gear the machine would run well up to about 45 miles per hour but above this it would vibrate excessively. This vibration ceased after the machine had been run 3,000 miles, even though the machine was speeded up to 50 miles per hour. The motor was pretty well carbonized at the time and showed a noticeable loss of power but still that vibration had ceased. This winter I gave the engine a thorough overhauling. I noticed that the different pistons with their respective connecting-rods varied as much as 1 1-2 ounces in weight, but not thinking that this variation was excessive, I made no attempt at balancing them.

I find that the motor vibrates just as it did last season when the machine is driven at any speed greater than 40 m.p.h. At 40 m.p.h. the motor is turning over only about 2,130 times per minute. The drive is through a jackshaft, meshing with the crankshaft by means of a bevel gear, and from the jackshaft to the rear wheel by a roller chain.

Will you kindly state what is the trouble? If the motor needs balancing, what is the best method of procedure? How should I balance the crankshaft if it is unbalanced and how am I to determine whether it is out of balance?

When my machine was geared 4 to 1, it was fully as fast as twin cylinder motorcycles of various makes but would not climb hills nearly so well even though these machines were geared a little higher, 3 3-4 to 1. I always had considered that speed was an indication of power but the machine's performance on hills did not bear me out in this. Why is this?

Salt Lake City, Utah. READER.

—There is no doubt that the motor is out of balance and, in a motor of the size you describe, a difference of weight in the different pistons of as much as 1.5 ounces would be sufficient to cause vibration. You would probably find that the motor would run smoother with the pistons and connecting-rods all of the same weight than it does with them varying as much as you mention. The only way which you could balance the crankshaft would be in a Norton running balance machine or some similar device and this you would have to have done for you by the engineers of a plant in which the running balance apparatus is installed. It is probable that in changing the load through rearranging the gear reduction, the crankshaft has become unbalanced.

Regarding the relation of speed and horsepower, there is no definite interrelationship between the two and no rule which states that the maximum horsepower is being exerted at maximum speed. In fact the contrary is the case. The motor may continue to revolve at a greater speed after the power curve has reached its peak. This can be made clear by the study of a characteristic power curve such as is shown in Fig. 2.

Gear Ratios of Representative Cars

Editor THE AUTOMOBILE:—Would thank you to furnish me with the information as to the gear ratios of the following cars on their lower speeds with respect to their high, i. e., considering the direct drive as 1 to 1.

Stutz, Mercer 1914, Mercer 1915, Marmon 41, Simplex, Packard 48.

New York City. SUBSCRIBER.

—The gear ratios of the cars you mention are as follows: Stutz H. C. S., 4 to 1; all other Stutz models, 3.5 to 1; Mercer 1914, 3 to 1; Mercer 1915, 3.5 to 1; Marmon 41, 3.77 to 1; Simplex 38, 2.75 to 1; Simplex 50, 2.13 to 1; Packard 48, 3.93 to 1.

Wants Berth in Ford Car

Editor THE AUTOMOBILE:—Will you please tell me how to convert the front seat of a Ford touring car so as I can make a berth out of same? Would like a cut showing this as I want it to fit out a car for the Panama Exposition.

Savannah, Mo. W. H. BROWN.

—There are two methods by which a Ford car can be transformed into a sleeping car, both of which have been successfully tried by tourists. The first was fully described in an article which appeared in *Motor Print* for August, 1914. With this scheme there is a collapsible mattress which forms a decking of reinforced canvas stretching from the top of the rear seat forward over the top of the front seat. When folded it is but 6 inches in diameter and 6 feet long. It is fastened by straps to the windshield support and to the iron arm that supports the top of the car. Beneath the roll on the running board, the mess equipment and blankets are secured and these keep the mattress from bounding about as the machine is in motion.

The mattress can be made at very little expense. A piece of canvas approximately 10 feet long by 6 feet wide, according to the size of the car, and some strips of tough wood constitute the bill of material. The piece of canvas is folded or doubled back until the piece is about 6 feet long and the width of the car seat on top of the back. The mattress slats, which should be 1.5 inches wide by .5 inch thick and

6 feet long, are placed from 1 to 1.5 inches apart, depending upon the weight they are to support, between the canvas and are securely tacked in place.

At the foot of the mattress a piece must be cut out to fit around the steering wheel. On the Ford car it is not necessary to fix straps to the corners of the mattress to hold it in place, although two straps, one at either back corner, will keep the contrivance from tilting up when crawling into the berth from the end.

The other scheme for making a berth in a Ford car is to alter the design of the front seat so that the back of it can be tilted backwards on a hinge until the bed is formed across the back seat, the back of the front seat and the front seat itself. A heavy blanket can be laid over this improvised berth and very good results obtained. If a longer bed is desired, the lower part of the front seat can be tilted upward on another hinge to provide the extra length.

Inadvisable to Install Pressure Feed

Editor THE AUTOMOBILE:—Is there any possible way in which I can install a pressure feed oiling system on a Cole 6-60 1914 model?

Buffalo, N. Y. A. C. STROHM.

—It might be possible to install this pressure feed but it would not be advisable. In the first place, a great amount of special engineering work would be required and many new parts, such as a hollow crankshaft and the pump itself. This would entail a great outlay of money which would not be justifiable because after the system had been worked out and installed on the motor, the undertaking would, in every sense of the word, be an experiment. The motor used in the Cole car is of Northway manufacture and the oiling system has been carefully worked out and proven to be satisfactory. It is therefore unnecessary to change it as any troubles you may have been having with it are not due to the original design but to some local defect which has come up and which can probably be readily cured in a much more simple way than by altering the entire system.

Text Books Not Up to Starter Art

Editor THE AUTOMOBILE:—Kindly advise me where I can secure some good literature in book form on electric lighting and starting systems. Also storage batteries and their care.

2—Please tell me what make of motor is used on the Pullman Junior car made at York, Pa., and also where it is made?

Baltic, O. PERCY S. GERBER.

—The art of the successful electric lighting and cranking system has advanced so rapidly since its inception 4 years ago as an important factor in automobile design, that there is no book which thoroughly covers the field in either a good analytical or descriptive manner. The same may be said of

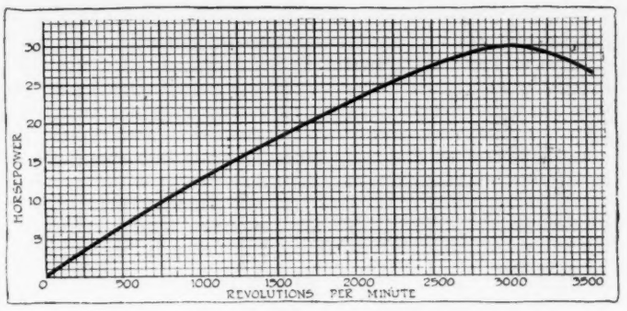


Fig. 2—Typical horsepower curve, showing how power drops off, although r.p.m. increase above the peak point

the storage battery which is used for electric lighting and starting. As regards the care of both the best information and the most carefully compiled data is to be secured from the literature published by the manufacturer. The makers of electric lighting and starting systems and of storage batteries have issued careful instructions and diagrams covering their products in a methodical manner. As for the design of either, insofar as we have record there are no text books which are advanced enough to be said to cover the art in its present stage.

2—The motor used on the Pullman Junior car is manufactured by Golden, Belknap & Swartz, 1248 Grand River avenue, Detroit, Mich.

Oil Strainer Probably Dirt Covered

Editor THE AUTOMOBILE:—I have a Maxwell-40 which does not get a continual supply of oil. The oil will flow through the oil sight feed for a while and then stop. If the engine is stopped the oil will flow again but not until then. The pump is in good condition. The oil line is clear and there are no air leaks. If you know of any remedy for this, kindly let me know.

2—A short time ago there was printed in THE AUTOMOBILE an item regarding a test made with a Marmon 41, with a substitute for gasoline. I think that rain-water is one of the things used in the substitute. I would like, if possible, a full description of the manufacture and materials used in the making of this substitute.

Rome, N. Y. PAUL GOETZE.

—From the description you give it is very difficult to state exactly what the cause of your trouble is. It may be from several causes, for instance, it may be possible that the pipes leading to the sight feed and motor are clogged and it is suggested that you disconnect all of these pipes and thoroughly clean same. The pump of the Maxwell-40 takes oil from a long tube-like strainer screwed in the bottom on the side of

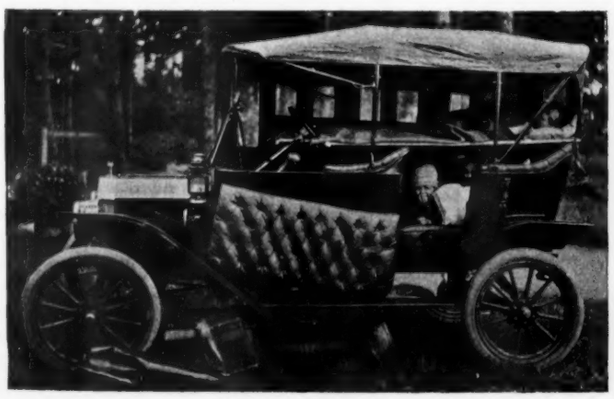


Fig. 3—Ford car provided with a berth formed by a collapsible mattress

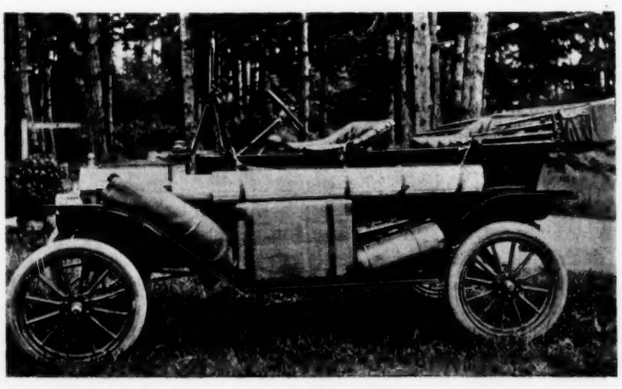


Fig. 4—Showing collapsible mattress and other baggage strapped in position

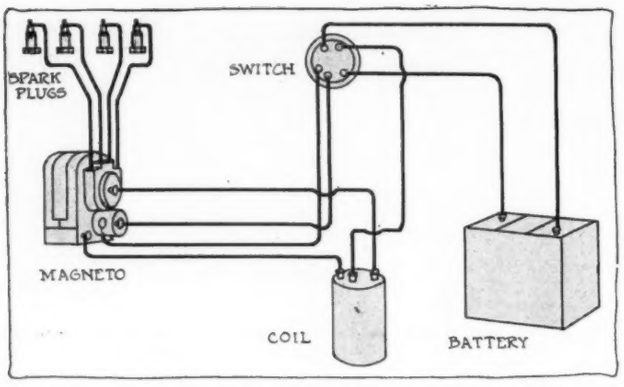


Fig. 5—Wiring diagram of ignition on the Chalmers 1913 model

the case. This often becomes covered with dirt and lint, causing the pump to work badly. It is always necessary to disconnect the oil pump and take out this strainer occasionally and remove all dirt and sediment. It would be a good thing, also, to examine the pump and see if the packing is worn out. If it is, it should be renewed. All the pipes are direct lines and if cleaned and free from trap, the only trouble can be in the pump or strainer. The remedy will therefore be to repair the pump and clean out the strainer.

2—The material to which you refer was known as Zoline and the full details of the process were never made public. The manufacturing cost of the article was shown to be much greater than that of gasoline and hence the project was abandoned.

Valve-in-Head and Rotary-Valve Motors

Editor THE AUTOMOBILE:—Kindly give me the names of firms making valve-in-head motors in four or six-cylinders of the following dimensions: 3-inch bore and over and 4 1-2-inch stroke and over.

2—Are there any rotary valve motors made for the trade other than the one used in Speedwell cars?

New York. O. C. SELZER.

—Concerns using overhead valve motors are the following: Buick, 3.75 by 3.75; 3.75 by 5; Chevrolet, 3.687 by 4; Great Western, 3.75 by 5.75; Grant, 2.875 by 4.25; Franklin, 3.625 by 4; Dorris, 4.375 by 5; Cunningham, 4.75 by 5.75; Interstate, 3.5 by 5; Kearns, 2.875 by 4; Morse, 4.625 by 5; Oldsmobile, 3.5 by 5; Partin Palmer, 3.75 by 5.25; Peter Pan, 2.75 by 4.125.

2—At the present time there are no rotary valve motors on the open market in this country which can be purchased and used in connection with an assembled product.

Wiring Scheme of 1913 Chalmers

Editor THE AUTOMOBILE:—I have just purchased a 1913 model 16 Chalmers four-cylinder touring car and the wiring has been removed and would like to have you give me a sketch of same or tell me where I can obtain one.

Spooner, Wis. J. W. HARMON.

—The Chalmers car uses what is known as a dual ignition system which consists of a magneto which serves as a source of current in regular running, a storage battery which provides the current in starting the car, a transformer coil, a dash kick switch and a single set of four spark plugs. For starting on the switch and for reserve, the storage battery is relied upon, and this furnishes a low-tension current which is transformed into a high-tension current by the spark coil located on the sub-frame. The wiring of these units is shown in Fig. 5. The battery is a 6-volt 40-ampere-hour capacity with a charging rate of 5 amperes. It is contained in a water-tight metal box placed beneath the floor of the tonneau. From the battery the wires run forward inside the left frame to the coil fastened to the sub-frame. The battery should be recharged whenever its voltage drops to 5.4 and should be tested every 2 weeks. The coil is located just beneath the front seat of the sub-frame and the magneto is on the left side of the motor towards the rear.

Financial Status of Chevrolet Company

Editor THE AUTOMOBILE:—Can you give me any information in regard to the organization, capital stock, real investment and bonded indebtedness of the Chevrolet Motor Co.?

2—I have a 1912 car that leaks oil through the holes in the flywheel on the clutch, thereby causing the clutch to slip. Can you suggest any way to fill up the three holes in the flywheel in order to lessen the amount of oil leaking into the clutch, without removing the flywheel from the car and having it soldered or welded?

Allentown, N. J. E. DILATUSH.

—According to the officials of the company, the authorized capital of the Chevrolet Motor Co. is $2,000,000 of common stock and $500,000 of preferred. The stock which has been issued to date consists of $1,323,850 common and $235,100 preferred, or a total capital of $1,558,950.

The net assets of the company after deducting all questionable accounts and after setting up strong reserves for depreciations and to meet any contingencies, are $1,696,553.77. This is drawn from the company's statement of April 1, 1915.

Of the above named net assets $427,707.99 is invested in plants and equipment. The balance of the assets consist of new merchandise in process of manufacture. Cash balance in banks April 1, 1915, was $464,007.21.

The Chevrolet company does not owe any mortgages; has no bank indebtedness of any kind and has discounted all its bills for the past 2 years; it has no bonds out and the business is active and in an exceedingly prosperous condition.

The company paid the regular dividend on its preferred stock on April 25. This dividend on the preferred stock is at the rate of 7 per cent. per annum. The company is not paying a dividend at this time on the common stock as it prefers to build up a surplus and strong reserve for safe expansion of its business and to meet any conditions which may arise in the future.

2—We cannot exactly understand the nature of the trouble as there are no holes in the Chevrolet flywheel through which the oil would be likely to flow. It is possible that your trouble is caused by the felt washer in the rear bearing having become worn. If you will remove the lower half of the crankcase and install a new crankcase gasket and a new felt washer in the rear bearing, being sure not to wrinkle the gasket when putting up the lower part of the crankcase, the trouble will probably be remedied. However, you do not state that the car referred to is a Chevrolet and if you will advise the make and model of the car, more exact information can be given.

Vacuum Probably Not Good

Editor THE AUTOMOBILE:—My Saxon roadster, model 1915, smokes badly and has used 1 gallon of oil in 100 miles. What is the trouble and how can I remedy it?

Laurelville, O. W. P. DEHAVEN.

—The Saxon motor is oiled by splash and when a splash system smokes, the trouble can generally be put down to either too high a level in the splash trough, too deep dipping of the connecting-rods or bad piston rings. The first two amount to practically the same thing, because if the level of the oil is too high, the connecting-rod is sure to dip too deeply into the oil and hence the effect is to splash too much oil to the cylinders. When the piston rings are faulty, the oil leaks past the rings and after it reaches the combustion space is burned in large quantities, thereby causing the smoking and

sooting. The proper course for you to pursue is first to determine the proper level in the crankcase which is exactly up to the bottom of the pipe plug P shown in Fig. 6.

The trouble with your oiling system might be in the leakage of air in the vacuum tank which controls the supply to the crankcase. If air leaks into the cap at the top the oil will flow out of the tank into the crankcase and the result will be such as you mention. Therefore, see that the filler cap on top of the reservoir is absolutely air tight. If you will do this and also see that the oil level is not above the plug in the bottom, your system will work all right. In the instruction books for the Saxon car attention is called to the danger of having air in the oil tank. They state in this that whenever the filler plug is taken off the tank or even loosened for any purpose whatever, enough oil must be put in the tank to bring it to the point of overflowing so that there will be no air space inclosed in the tank when the plug is put on. If this is not done no vacuum can form in the top and all the oil will run quickly into the motor and out of the exhaust pipe. If you have been in the habit of disregarding this warning the cause of your trouble is self-evident.

Valve Timing of Knight Motor

Editor THE AUTOMOBILE:—Will you please give me the valve timing of a typical Knight motor, such as the Stearns or Moline?

Princeton, N. J. A. K. CHAPMAN.

—The timing of the Stearns-Knight is as follows: inlet opens 4 degrees past top center; inlet closes 40 degrees past bottom center; exhaust opens 60 degrees before bottom center and closes at top center. The timing of the Moline is as follows: Inlet opens at 20 degrees past top center and closes 50 degrees past bottom center. Exhaust opens at 50 degrees before bottom center and closes at 5 degrees after the top center.

Wants Eight-Cylinder Motor for a White

Editor THE AUTOMOBILE:—What do you think as to the practicability of installing an eight-cylinder motor in a White 30 chassis? I have no doubt but that the factor of safety in the chassis is sufficient for the installation of such a motor. I would also like you to tell me just how much trouble it would entail to carry out my idea, also as to the clutch mounting, etc.

Atlanta, Ga. G. A. SIMPSON.

—While the factor of safety of the chassis is no doubt large enough to take care of the installation of an eight-cylinder motor, it would be impractical to attempt it on account of the difficulties in connecting up the clutch, etc. Considerable machine work would be necessary and the expense would be so great that it would not be justified.

7 Volts Needed for Starting Current

Editor THE AUTOMOBILE:—I have a 1910 Velie, with 4.5-inch bore and 5.25-inch stroke, low tension Splitdorf magneto and six-cell No. 6 dry battery ignition, model L Schebler carbureter. There are two switches so that the magneto and dry battery, Atwater Kent distributer, can be both cut in and worked on the two sets of spark plugs at the same time.

I read in THE AUTOMOBILE that it was a good idea when bringing the car in from a run to put some kerosene in the cylinders to cut the carbon and soften it up and so a couple of weeks ago when putting the car in the garage, I put some kerosene in the cylinders through priming cups and the next day I had trouble in starting the motor. One, two or three cylinders would fire and then I would have to crank again, but after several crankings, the engine started all right. The last time I had the car out, when I put it back in the garage I put some more kerosene in the cylinders, probably about three tablespoonsful in each cylinder, and about two or three nights after that I tried to start the engine but could not do so. The next night I tried again, cranking it for about an hour or so, priming with gasoline several times, but the engine would not start. One, two or three cylinders would fire and then the engine would stop. I took the spark plugs out and found a slight carbon soot on them. I cleaned them off and put them back with no better results. I seemed to get a good spark through the dry battery but did not test the spark from the magneto. Between these two times of putting kerosene in the cylinders I had the car out and it started satisfactorily. It is a hard engine to start, anyway, but I did not see the theory of it starting so hard after dosing with kerosene. Can you enlighten me on this and advise if the use of the kerosene is responsible?

Buffalo, N. Y. LEON SMITH.

—It would be a good idea to put a voltmeter on your dry batteries and see if they are giving you the proper current. You should have about 7 volts to provide good ignition current so that the voltage at the terminal will be at least 6. New dry cells will test approximately 1.5 volts a piece and when in really good condition you can sometimes use as few as four cells with good results. A fifth can then be added when the voltage drops and finally a sixth. With the sixth cell the current supply should last for a long time. If you test the cells with an ammeter, they should register 25 or better, but you must remember that in connecting cells in series the amperage remains practically the same, whereas the voltage of each added cell is added to the total; thus, for six cells having a voltage of 1.5 and amperage of 25 the resulting current will be of 9 volts, with little more than 25 amperes.

It might be possible that the presence of kerosene would have a slight effect on starting the motor, but this would immediately disappear if the motor priming cocks were open before the engine was started and the motor turned over several times to blow any residue out of the cylinders. The motor should then be primed and, with a good spark, will start immediately. Any motor with good compression will start if there is a charge in the cylinders and if the spark is as it should be.

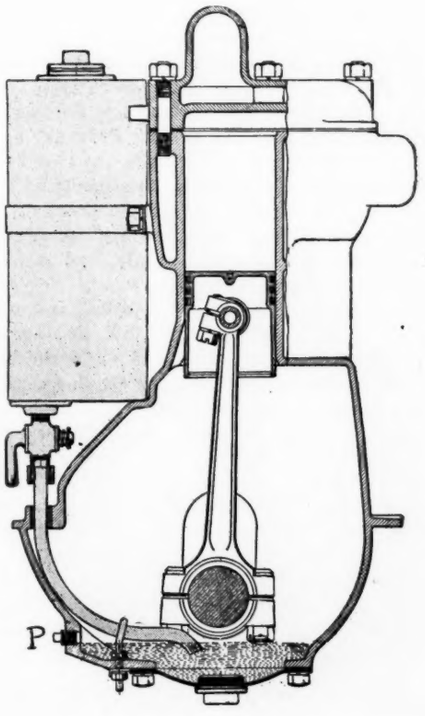
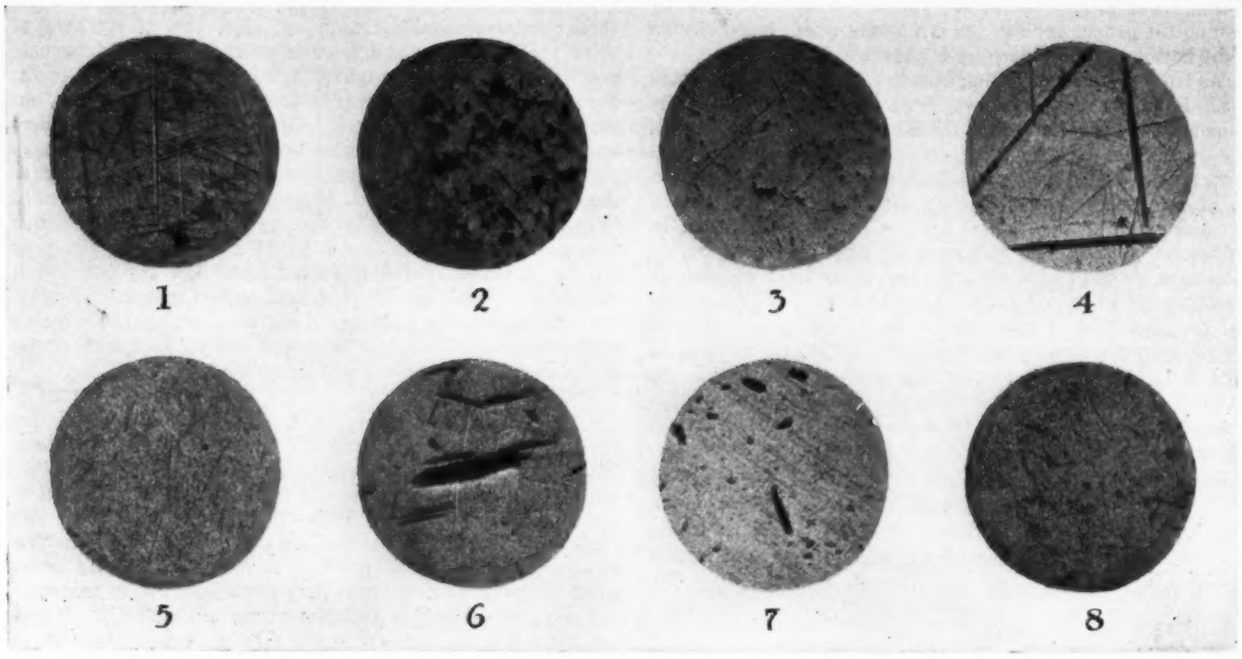


Fig. 6—Vacuum tank in position on the side of the motor of a Saxon roadster. If the cap is not fastened so that it is air-tight it will release the vacuum and permit oil to flow into the crankcase. The correct level of the oil is at the bottom of the plug P



Examples of different ball bearing surfaces examined under the microscope and magnified 120 diameters. Number 5 is an example of a Hess-Bright bearing

Ball Bearings in Theory and Practice*

Part II
Co-efficients of Friction and Methods of Lubrication of Extreme Importance in Bearing Practice

By B. D. Gray
Vice-President and Manager of the Hess-Bright Mfg. Co.

ONE of Stribeck's findings that completely reversed previously established theory was the relatively high carrying capacity and low friction of the ball bearing as compared with the roller. Prior to the knowledge gained from these tests, differences in the two were predicated upon the theory of a line and a point contact, assuming that there was a pure rolling action in both cases. But pure rolling is a theoretical possibility merely, requiring for its realization absolutely true shapes initially, and inelastic materials that will not change shape under load. For example, to produce a series of rollers truly cylindrical and alike as to diameter, also a perfectly cylindrical shaft, and a truly cylindrical box, within the requisite small limits of error necessary to produce pure rolling motion with perfect line contact, is difficult and commercially not realizable. The taper roller bearing presents still greater difficulties. Under heavy loads such accuracy as may be obtained is largely defeated by deflections of the machine framing or shafting. This causes the rollers to skew more or less, and it follows that the theoretical long line contact of the roller does not exist in fact, but is limited to a small fraction of the roll length.

One of our customers who has also used taper roller bearings and who has a well-equipped physical laboratory in which he has made numerous careful bearing tests informs us that the co-efficient of friction of our bearings is one-fourth that of taper roller bearings even when the latter are tested under the most favorable conditions—more favorable than are frequently obtained in actual service.

The co-efficient of friction for properly made ball bearings will average about 0.0015, while based upon the above mentioned tests the co-efficient of friction for taper roller bearings would average about 0.006.

A paper on Comparative Tests of Three Types of Line-shaft Bearings, by Carl C. Thomas, E. R. Maurer and L. E. A. Kelso (see A. S. M. E. Journal, Vol. 36, No. 3, March, 1914), gives interesting figures on the co-efficients of friction for Hess-Bright bearings, flexible roller bearings and plain ring-oiling babbitted bearings. I am giving below a tabulation of these based upon curves contained in the paper.

COMPARISON OF CO-EFFICIENTS OF FRICTION

Peripheral Speed of Shaft—150 Ft. per Min. Corres. to 235 R.P.M.

Bearing	Average Load per Bearing—727 lbs.		Average Load per Bearing—1227 lbs.		Average Load per Bearing—1727 lbs.	
	Temp. bearing 77° F. Coeff. Friction	Temp. bearing 100° F. Coeff. Friction	Temp. bearing 77° F. Coeff. Friction	Temp. bearing 100° F. Coeff. Friction	Temp. bearing 77° F. Coeff. Friction	Temp. bearing 100° F. Coeff. Friction
Ball . .	0.0025	0.0019	0.0022	0.0018	0.0020	0.0016
Roller .	0.0069	0.0055	0.0055	0.0047	0.0049	0.0042
Babbitt	0.0112	0.0075	0.0082	0.0058	0.0070	0.0051

It will be noted that the co-efficients of friction for all three types of bearing decrease with increase of bearing tempera-

*NOTE.—From a paper read before the Electric Vehicle Assn. of America, Philadelphia, Pa., April 14, 1915.

ture and load (for loads and temperatures given).

This same customer mentioned before as having experimentally determined that the co-efficient of friction of our bearings was one-fourth that of taper roller bearings, also states that a decided difference may be observed in the coasting properties of their automobiles when mounted on roller bearings and on Hess-Bright or other high-grade annular ball bearings. I found a great difference in the coasting of my Cadillac after replacing the taper roller bearings in the hubs with 2ROs. Unfortunately, however, it did not occur to me to measure the draw bar pull before making the change, and through lack of time and facilities this comparison has never been made. A prominent axle manufacturer has, however, made the statement to us that he made tests of this character, and found the difference in draw bar pull to be decidedly in favor of ball bearings.

In any tests of this nature the taper roller bearings are likely to be adjusted to a nicety. In actual service and in the hands of the layman or a careless chauffeur or repairman they may be adjusted so as to cause a tremendous increase in friction. As many of us know from experience, a taper roller bearing makes a fine clutch when set up endwise tightly with a nut.

The much vaunted adjustability of the taper roller bearing to compensate for wear is mythical. It is not susceptible of adjustment in the true sense of the word except when it is new and when all parts have been accurately made. If the cup or the cone has worn out of round, Fig. 13, or if any of the rolls have been unevenly worn, it is an absolute impossibility to adjust the bearing so that the rolls bear evenly all around, and any attempt to adjust it results in misalignment, undue stress and strains and probable early destruction of the bearing or correlated parts. The non-adjustable annular or 2RO bearing mounted in such a way that an inexperienced or careless person in removing it cannot replace it in any but the correct manner has a decided advantage over any bearing which may be adjusted.

Annular or 2RO ball bearings, if properly selected as to size, properly mounted and enclosed, are quite as reliable and durable as any other part of an automobile. Several years ago there arose in this country a feeling that annular ball bearings were not suitable for mountings where they would be subjected to considerable end thrust, and especially end shock, as in front hubs. The reason for this was due more to improper selection and mounting, supplemented by extensive advertising of roller bearings, than to inherent fault in the ball bearings. A number of automobile manufacturers have retained annular bearings in the front hubs of their cars with most satisfactory results. Abroad practically no roller bearings are used in automobiles in any location. The annular bearing is almost universally used throughout the car, and has not been a source of trouble in hubs, as was claimed for it in this country. It is said by some that the excellent roads in Europe do not impose such severe service on wheel bearings as the poor roads in this country. From personal experience in driving 16,000 miles in five countries on the continent, I am convinced that hub bearings on European cars do not have an easier time of it than those in the hubs of cars used in this country. My personal experience also with the Alco and Berliet cars made in this country convinces me that the ball bearing is not only adequate but the best for the purpose if properly selected and mounted.

As I have already pointed out, the theoretical line contact of roller bearings is only rarely obtained, since it depends upon extreme accuracy of manufacture of the cup, cone and rolls, upon perfect alignment and upon keeping the rolls in their proper position. In the ball bearings we have not a point contact, as many suppose, but a substantial area due partly to deformation and partly to the shape of the parts in contact; I refer to the concavity of the ball path or grooves whose radius in one direction very nearly coincides with that of the ball.

This was very clearly brought out in a test which we made a short time ago. One and one-half inch diameter balls in contact with a flat disk, a grooved disk and a cupped disk, as shown in Fig. 14, were subjected to a load of 10,000 pounds in our testing machine. Vitriol was applied around the contact points and allowed to etch the exposed surfaces; that is, those which were not actually in contact. Then the load was relieved and the contact diameter was measured by means of a micrometer microscope. In the cases of the flat and cupped disks the areas of contact were circular, but in the case of the grooved disk the area of contact was elongated, resembling an ellipse. The pressure per unit area was computed and found to be:

Flat surface	581,395 lbs. per sq. in.
Grooved surface	212,766 lbs. per sq. in.
Cupped surface	146,413 lbs. per sq. in.

This test shows clearly the reason for the increased carrying capacity of the curved (grooved) ball track type of bearing as against that type with flat or practically flat tracks. It is self-evident that the more closely the groove envelops the ball the lower will be the pressure per *unit* area and hence the greater will be the ability to carry load.

As an indication of the capacity and durability of ball bearings, I will give you the results of a test recently completed. A No. 6407 bearing was subjected to a radial load of 3,500 pounds and thrust load of 1,750 pounds and run continuously at 1,445 r.p.m. for 531¼ hours before failure occurred.

This bearing has a bore of 35 millimeters (1.3780 inches), outside diameter of 100 millimeters (3.9370 inches) and a width of 25 millimeters (0.9843 inch).

To get an idea of what the above radial and thrust figures would be the equivalent of in automobile front hub service, let us assume a 36-inch wheel running at 1,445 r.p.m. This would mean a speed of 154.6 miles per hour. A run of 531¼ hours would be the equivalent of 154.6 x 531.25 or 82,141 miles.

Also assume that two bearings are used to a hub, one carrying 3,500 pounds radial load and 1,750 pounds thrust, while the other carries 3,500 pounds radial load only. The total radial load per hub would then amount to 7,000 pounds per hub, and with four hubs (assuming the rear hubs carry the same load as the front hubs—in the average car they carry more) the total load would be approximately 28,000 pounds.

Based on the above, conservatively, this would be the equivalent of 82,141 miles in the front hub of a car weighing (with live load) 7,000 pounds and running continuously at 154.6 miles per hour (allowing a factor of 4 for shock).

Of course, in the final analysis, relative capacities of ball and roller bearings can best be determined by test, but we do not fear any comparative test made without prejudice.

The question of lubrication is a matter of such vital importance to the satisfactory operation of ball bearings that a

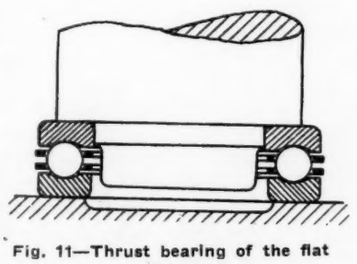


Fig. 11—Thrust bearing of the flat type

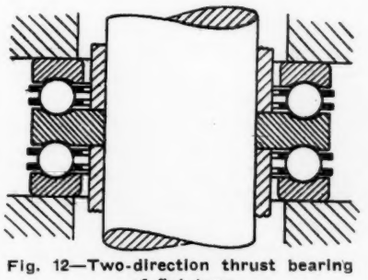


Fig. 12—Two-direction thrust bearing of flat type

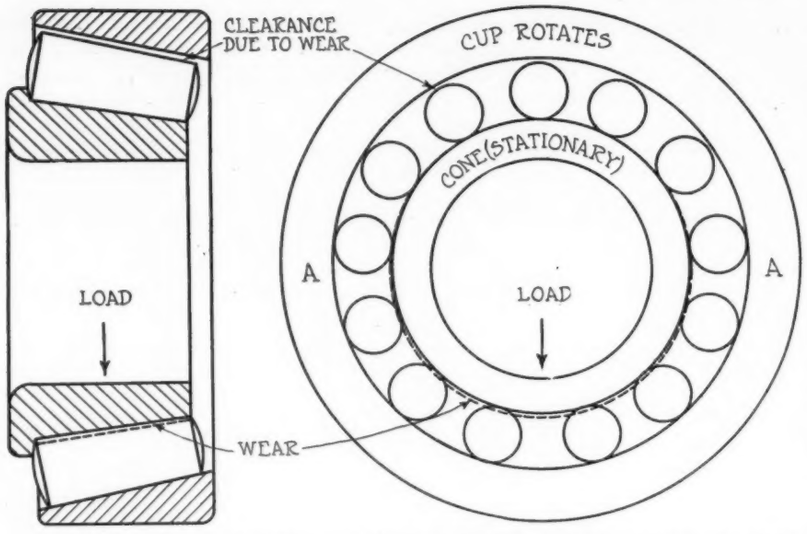


Fig. 13—Showing the functions and clearances of the different members of a taper bearing which has undergone wear. Clearance Due to Wear—Clearance between cup and rolls due to wear of lower surface of cone. Wear—Dotted line indicates original shape of cone before wear has occurred. Any attempt to adjust for wear produces pinching of rolls amounting to a maximum at points A and correspondingly less at other points

paper of this character would hardly be complete without some reference to it. Several years ago one of our representatives, W. L. Batt, covered the subject very fully for the *American Machinist* and I herewith give extracts.

"Oil is essential for the operation of plain bearings, but it is not so well known that ball bearings likewise require a certain amount of lubrication; it is all too frequently assumed that the latter may run entirely dry.

"Contrary to this assumption, lubrication has a very positive action in a ball bearing. This action is many fold, existing both between the ball and the path upon which it rolls and between the ball and the separator. Though the principle of the ball bearing is a rolling one, there is in the most perfectly designed bearing a sliding action which, however slight, must yet be provided for. If balls and raceways were absolutely incompressible there would in practice be solely point contact and therefore, a pure rolling action, but as far as present-day mechanical processes go, even the most perfect of materials are somewhat elastic, and there is an actual area of deformation between the ball and the raceway under load. At the extremities of this area, whose diameter is, of course, very small, sliding must exist, but the presence of a lubricant at this point renders what small amount of friction there is almost negligible. Improbable as it may seem, there is an actual film of lubricant maintained between these surfaces of contact, however minute they are, providing the lubricant be one of sufficient viscosity.

"Aside from its lubricating quality, oil or grease acts as a protecting agent for the ball bearing. The finely polished surfaces of the balls and raceways are subject to attack by rust through atmospheric action and may be damaged by the entrance of foreign matter from the outside, such as grit and dust. Lubricant effectually surrounding the bearing will not be penetrated by this atmospheric moisture, and thus the surfaces of action are preserved in their original finely polished condition.

"In order that the lubricant may in itself be no source of danger, it must respond to certain requirements; incidentally, requirements exacted of the ball bearing lubricant are thoroughly desirable in one to be used in plain bearings as well.

"First and most vital is the requirement that the lubricant of itself shall do no damage to the bearing, neither originally nor through deterioration. The most common fault in oils is the presence of free acid or its development. Free acid is never found in properly refined mineral or hydrocarbon oils, nor will these deteriorate due to the action of the atmosphere, and therefore the only kind of oil satisfactory for ball bearing lubrication is mineral oil. Vegetable oils, such as castor, cotton-seed, rape, linseed and the like, are barred, principally because of their tendency to gum up, become rancid and develop acid. The animal oils are objectionable for the same reason. The so-called petroleum greases, among which are vaseline and cosmoline, have no detrimental action in themselves, since they are derivatives of mineral oil; they have, however, low viscosity and a low melting point; 100 to 125° F.; they pound out thin in action and have little lubricating value. Their use is limited to very slow speeds and their chief advantage is low cost.

"Just as acid is a thing to be guarded against in oils, so is free alkali the most common enemy to ball bearings, among the greases. The familiar yellow cup grease is usually a combination of a mineral oil and some vegetable or mineral oil or fat, which latter is saponified by the addition of a caustic; the result is a lubricant having body and stiffness. The saponifying material should be small in quantity and very carefully compounded, else free alkali, having a detrimental action on the steel may result. The action of an alkali, as of an acid, is to pit or etch the surfaces upon which it is deposited.

"The addition of mica, ground cork, wood and such substances, frequently added to overcome noise in gear cases of automobiles, is a positive menace to the ball bearing, since this foreign matter opposes free ball rotation; if it be present in large enough amount the result may easily be that the balls are wedged between the raceways and actual fracture may result. Certainly the free rolling quality of the ball bearing will be lost.

"The question of the beneficial effect of graphite in ball bearing lubrication is one often asked. The answer is simply that graphite in any shape or form that will settle and pack with time when quiescent cannot be of assistance to the ball bearing itself."

Parenthetically.—Some time ago we made a few tests of graphite oils and greases as ball bearing lubricants. We tested a No. 308 bearing running under 100 per cent. overload and using a graphite oil as the lubricant. The test was normal in every way and nothing unusual was noticed. After a run of 337 hours the bearing was removed and examined, and it was noticed that a considerable amount of wear had occurred—much more than was the case in similar tests where only a pure oil or light grease was used. The only conclusion we can draw from this is that the graphite in the oil, in spite of its being extremely finely divided and practically impalpable, had a slight abrasive action and that it does not improve the running qualities of the bearing. On the contrary, it is slightly injurious and tends to increase the friction slightly over that when oil alone is used.

Another test was conducted with a graphite grease which the manufacturers recommend for the lubrication of ball and roller bearings. It was a heavy grease with finely pulverized graphite. A trial was made of this by putting a quantity into the thrust bearings of one of the heads of our endurance testing machine. After a run of a few days the head became very noisy and finally locked the shaft. Examination of the bearings disclosed very distinct and somewhat irregular markings

in the ball tracks—something like long chatter marks—as if the graphite had caused each ball to slide a short distance, thus slightly abrading the surface of the steel, until a little mound of the graphite had packed so hard under the ball that it was forced to roll over, only to repeat the sliding until another mound of graphite had packed under it.

These results show clearly that graphite has no value in so far as reduction of ball bearing friction is concerned, and while it may be of considerable value to the other elements carried upon the ball bearings themselves, such as transmission gears, etc., the possible source of damage to the ball bearings cannot be overlooked.

The effect of speed upon the choice of lubricants should also be considered. As a general statement, greases are suitable for low speeds, while oils are preferable for high speeds. Oil is really the better all around lubricant. It should be of sufficient viscosity to maintain a film between the pressure surfaces, and the quantity used should only be enough to cover the surfaces—at high speed—the less the better. Oil is more difficult to retain in the bearing box than grease. This, however, is merely a detail of design, since it is an easy matter to design a box that will not leak oil, and then it is simply a question of good workmanship to make sure that the joints are tight.

Quoting again from Mr. Batt's paper: "In order that the lubricant may be effectually retained, various arrangements are used, depending upon the conditions surrounding the bearing. In the simplest sort of mounting for a radial bearing the shaft projects through the casing, and the casing itself is provided with two lips, between which is a space for lubricant. If the conditions be such that additional protection is needed, one additional groove is provided and this may be fitted with a cup of some sort from which grease will be steadily fed to the groove to keep that filled. This makes a definite frictionless packing. For still more severe conditions a third groove is added; in this latter groove felt is occasionally placed, whose adherence to the shaft is guaranteed by some sort of spring tension. Unfortunately, this is subject to drying out and thus loses its efficiency; when that occurs it is a positive detriment.

"The single or multiple-groove arrangement, empty or with only grease filling, is the most effective; but it is essential that the bore of the lips be not more than 1-64 inch larger than the shaft in diameter, that the lip edges be sharp instead of rounded over, and that the lips be at least 3-32 inch wide. The grooves may also be cut in the shaft, leaving bands between with sharp edges. The only objection to this is the weakness of the shaft."

In closing, I feel that a few "Don'ts" for ball bearing users would not be out of place, especially since the majority of us are users of ball bearings in one way or another. These don'ts are particularly for the automobile owner, but are also generally applicable to the user of any machinery having ball bearings.

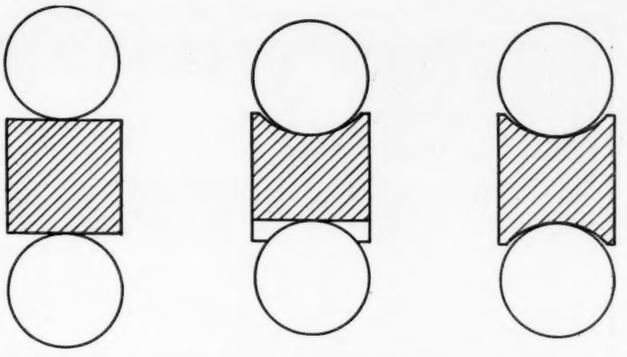


Fig. 14—Three types of race. Left, flat disk; Center, groove disk; Right, cupped disk

Don't let the bearing fill up with grit.

Don't let acid get into the bearing. Always use a neutral lubricant.

Don't let water get into the bearing. In washing an automobile, especially the wheel hubs, be careful not to let the stream of water under city pressure play directly against the inner end of the hub.

Don't let oil leak out of the bearing.

Don't believe the man who says a ball bearing will run without oil.

Don't use grease containing foreign fillers, such as sawdust, ground cork, etc. These may be of value in deadening the sound of gears, but they are injurious to ball bearings.

Don't take a bearing apart—if you want to play with it, get an extra one.

Don't put new balls in—send the bearing to the manufacturer if you think they are needed.

Don't set a thrust bearing up until it resists rotation. Ball bearing friction is so low as to be perceptible to the touch only under excessive loads.

(*Continued on page* 903)

[NOTE—The illustrations shown below were reversed in the first instalment and are shown herewith with proper captions.—Ed.]

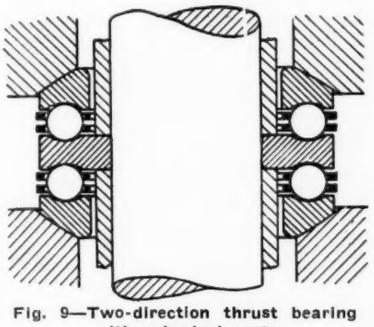


Fig. 9—Two-direction thrust bearing with spherical seats

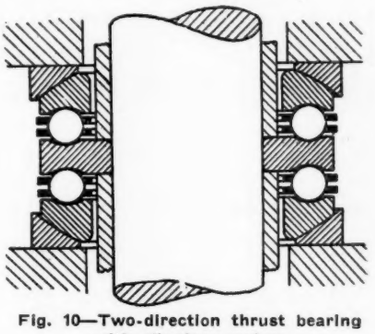


Fig. 10—Two-direction thrust bearing with aligning washer

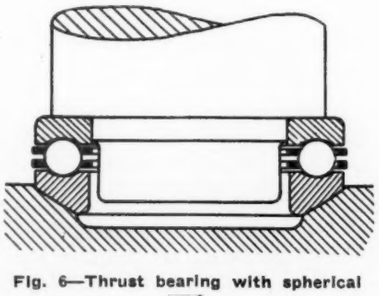


Fig. 6—Thrust bearing with spherical seat

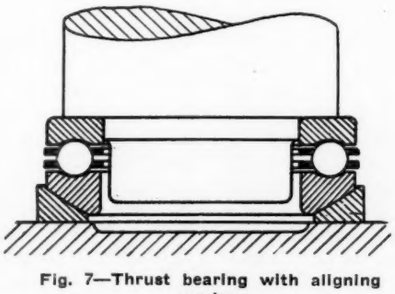


Fig. 7—Thrust bearing with aligning washer

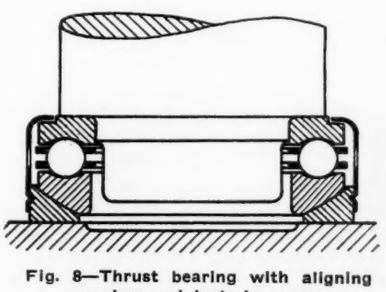


Fig. 8—Thrust bearing with aligning washer and inclosing case

Main exhibition hall and exterior view, from Kaiserdamm, of building erected in Berlin to house international automobile show

Berlin's Motor Show Building

GERMANY'S international automobile show, which was to have been held in September 1914, came to naught on account of the more important business in which the country became engaged in Belgium and elsewhere, but the large building which had been erected to house the exposition, and to remain for similar occasions requiring a vast covered space, was formally opened in January. The main show room is about 730 feet long by 162 feet wide and parallel with it there are two side halls 700 feet long and 39 feet wide. The height of the main hall at the middle is over 60 feet. At the North end there is the inevitable Kaiser entrance, comprising five ornamental portals and a large Kaiser *loge* which can also be used for an orchestra and two large assembly halls. Altogther the area is more than 180,000 square feet. At the South end there is a restaurant which can be reached from the street as well as from the exposition, the street being the new boulevard called the Kaiserdamm. The ground which the building occupies was originally very hilly and a trace of this formation remains in the form of a slight general slope of the floor from East to West. The floor is only hard sand, with a view to laying any special flooring over it when required, it is said. A large steam heating plant in a basement at the Southwest corner supplies the side halls and the assembly rooms through radiators but presses heated air directly into the main hall, the restaurant and the kitchen through slits in the architectural iron work. The latter is very unobtrusively worked into the decorative and color scheme. It is especially noticed that the large trussed arches supporting the roof are kept almost flush with the skylights within the building while clearly showing their substantial dimensions as ribs on the outside of the roof. The main entrance is at the middle of the West side and comprises seven columnar portals flanked with two special entrances in low square towers serving as bases for terraced pedestals topped with massive sculpture representing automobiles with wings—this being the artist's way of indicating that the hall is for aeroplane expositions also. On the East side, opposite the main entrance and fronting Rognitz street, are the offices of the building, parlors and telephone booths. Exhibits are taken into the building through a basement extending under a large portion of this side, the rise of the ground making this basement easily accessible from the street.

Elaborate electric lighting in conjunction with a striking yet not garish coloration of the interior and a studied plainness of the architectonic lines are among the features mentioned with special pride of achievement, as they are believed to produce a pleasing artistic sense of fitness, while being

very economical in making it possible to dispense with all other comprehensive decoration for any occasion for which the building may be used. Perhaps it is now used for a hospital for wounded soldiers or for prisoners' barracks.

This large and permanent structure, claimed to be the largest in the world, was erected in seven months. The *Verein Deutscher Motorfahrzeng-Industrieller* (Association of German Motor Vehicle Manufacturers) and the *Kaiserlicher Automobil Club* worked together in planning, financing and pushing the enterprise to completion.

Discussion of "The Improvement of Spring Systems"

Contributed Views on Horizontal Springing, Steering, Skidding and Bouncing

With Comments by M. C. K.

COMMUNICATIONS from members of the industry continue to be received on the subject of the horizontal element in road shocks, its various effects and the means for making it harmless. The two shorter letters bear witness of the interest taken in the matter and of the desire for having the shortcoming which crops out in the standard spring suspension at this point taken care of in practical construction. No comment seems to be necessary.

Testimony from the Road

Editor THE AUTOMOBILE:—I have read, with much interest, the discussion of "The Improvement of Spring Systems" and certainly agree with M. C. K. From my own personal experience I am fully convinced that air tires do not absorb horizontal shocks that are at all severe. These shocks are resisted by the strength of parts other than the springs.

The lack of cushioning means on front axle to take the horizontal shock is responsible in a great many cases for damage done to steering gear and component parts. I have seen one severe accident which was caused by steering arm breaking as the result of driving over rough roads and this car is fitted with large air tires. Most springs now in use can take shock in one direction only, vertically.

Syracuse, N. Y. May 1, 1915. F. Mc. V.

New Way of Appraising Shock Values

Editor THE AUTOMOBILE:—The writer has followed with more than usual interest the articles on "The Improvement of Spring Systems," by M. C. K., in particular those dwelling on the question of horizontal components, and how they should be absorbed. After due consideration of the matter it seems that horizontal components do exist to a considerable and annoying degree, and this is graphically illustrated in the accompanying set of curves.

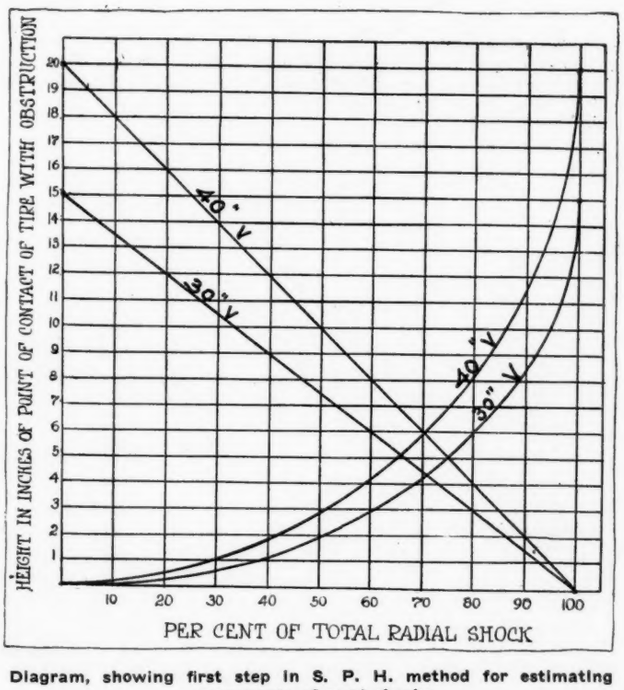
Instead of showing the relation of the horizontal component to the vertical component, these curves show the relation of both components to the total radial shock. The ordinates represent the height in inches of the point of contact of the tire with the obstacle, while the abscissae show the per cent. of the total shock. Curves marked "H" show the horizontal components with the different sized obstacles up to the height of the wheel center for both thirty and forty inch wheels. Curves marked "V" show the corresponding vertical components. It will be seen that with thirty inch wheels an obstacle of an inch and a half gives a horizontal component of very nearly half the size of the vertical component, and an obstacle of two inches gives a horizontal component equal to half of the total shock. An obstacle a little less than four and a half inches high gives a horizontal component almost three quarters as great as the total shock, and equal to the vertical component, and all obstacles above this height of four and a half inches have a greater horizontal than a vertical component.

With larger wheels one would naturally expect less shock, and this is found to be correct. With forty inch wheels it takes a two inch obstacle to give a horizontal component equal to half the vertical components; a two and three-quarter inch obstacle to give a component equal to half the total shock; and a five and three quarter obstacle to give a horizontal component three quarters as great as the total shock, and equal to the vertical component, above which height the horizontal components are greater than the vertical components.

These figures do not take into consideration the fact that the total weight of the car works against the obstacles horizontally as momentum, while only the weight on the axle concerned works vertically. So the relative size of the horizontal components will be much larger than stated above for the conditions given. From all these considerations it would almost seem that there might be conditions where horizontal spring suspension would be even more desirable than vertical spring suspension.

The main consideration, then, is to secure the proper method to successfully absorb this horizontal component as well as we now absorb the vertical component. The former has been taken care of to a lesser degree by tilting the spring at the same angle that the axle is tilted, somewhere in the nighborhood of four degrees. In this manner the springs may absorb a small proportion of the horizontal component of certain shocks, but for the majority of cases, especially with the larger obstacles, it is impossible to absorb them in this way.

Not being provided with a proper method of suspending the horizontal component, the frame is called upon to absorb it with results only too well known to discuss. But in being transferred from the tire to the frame, the horizontal component makes quite a journey, leaving strain and wear all along the line on wheel bearings, steering spindles, steering connections, steering gear, springs, spring clips, spring bolts and frame. Consequently the solution to the absorption of the horizontal component should eliminate or reduce to the



Diagram, showing first step in S. P. H. method for estimating components of road shocks

minimum the shock to all these parts, and must be so constructed as to keep the car on the road without difficulty, and at the same time coupled with simplicity so as to make the manufacturing problem as economical as possible.

Detroit, May 3, 1915. S. P. H.

Shocks Need Not Reach Steering

The well known pioneer constructor, Charles E. Duryea, whose extensive experience with light cars ought to be valuable, seizes upon the fact that the horizontal element in a shock reaches the steering gear primarily because the front axle is articulated and that there is a remedy, therefore, which is more radical than cushioning of the offending element in the shock can be. His letter, which also touches upon several other matters of interest, follows.

The Views of a Pioneer

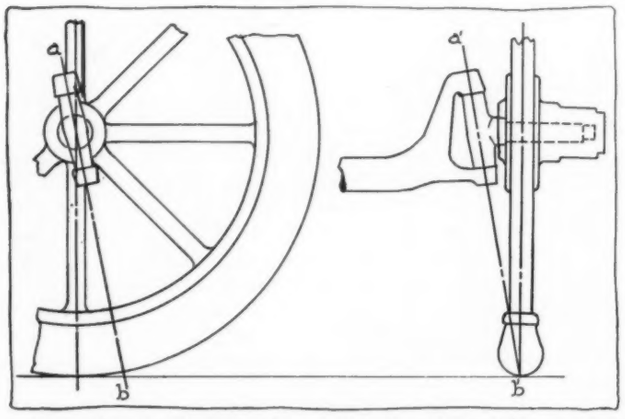
Editor THE AUTOMOBILE:—I have read C. A. D.'s statements on the steering matter on page 810 with much interest. What he says is all right but what surprises me is that engineers and the public generally do not know that "the reaction of the front wheels about their steering spindles" can be practically reduced to zero by a construction that costs no more, is just as strong and simple and is better all around. With the example of the bicycle and its perfect steering before us every day surely no one need be in ignorance of what good steering can be. There is no such "reaction" to the front wheel of a cycle. It will go over a brick "hands off."

Auto steerings can have this same perfection; this same freedom from shocks and tendency to turn around their steering pivots. Autos have been built that way in America for at least 23 years.

THE REQUIRED CONSTRUCTION

What is the answer? Simply that the steering pivot line extends into the plane of the wheel slightly ahead of the point of tire contact on the ground. This is done by giving the pivot line a slight inclination. Usually from 6 to 12 degrees is required. See sketch. It is just as easy to forge steering knuckles with the proper angle as with none. The difference in cost of machining is nothing after the jigs are made. The benefits are many. A vehicle fitted with this proper steering will run over a common brick with no shock to the steering whatever. It will take much larger obstructions with safety. Here is an example. At one of the early Chicago Shows when the policemen were more lenient than nowadays, it was my demonstrating stunt to take a lever steering vehicle out onto Michigan avenue and run two wheels diagonally over the corner of the curbing at the cross streets; and this without holding the lever while the wheels struck the curb and went over it. Those curbs are about 5 inches high as many of your readers know, and striking them at an angle of about 45 degrees tended very strongly to deflect the wheels but thanks to the superior qualities of the steering they were not deflected. Further tests were often made. One, for example, was that of taking off the tie bar connecting the two front wheels and leaving one free. By steering the other wheel the vehicle could be taken practically anywhere over ordinary roads. I have driven across car tracks, turned around in a street having double car tracks, driven though sand, climbed small hills and done similar feats with the tie bar not in place.

When will the public wake up and demand of the makers this superior thing? When will engineers quit talking about "Irreversible steering gears" and the shocks they must withstand? Why build wrong?



Forward and outward rake of steering pivot which protects steering gears and drivers against annoying effects from horizontal shock component

FORE-AND-AFT SPRINGING

As to fore and aft springing. There is room to go wrong on this. The old Victor spring-fork bicycle was a case in point. It was perfectly free to yield fore and aft. When the wheel came to an obstacle that the momentum of the wheel was not sufficient to carry it over, the wheel stopped and stood against the obstacle until the rear wheel and frame could compress the spring fork enough to force the front wheel over. This stopping and having to be started again took power and the bicycle was heavy to propel although beautifully springy. The best action obtains when the wheel may yield backward slightly as it rises over the obstacle, to the end that part of the propulsion energy may be diverted to lifting the wheel instead of requiring wholly extra energy for the lifting purpose.

WHAT PREVENTS SKIDDING?

Concerning O. W. H.'s remarks and skidding my experience may be of interest. After building pneumatic tired motor vehicles for a dozen years I built a number using solid rubber tires and continued this for about 5 years. I found less tendency to skid but more tendency to bounce. This is easily understood. Just as a skate or a sled runner skids sidewise less easily than a toboggan, so a solid rubber tire grips the surface better than a pneumatic. Recognizing the advantage of edges and narrower surfaces most tires now are provided with rough threads, usually by ridges or knobs raised above the surface but often by grooves in the tread. Having built vehicles for years that were practically free from skidding I consider it more a matter of proper weight disposition than of tire size or surface. On ice or greasy asphalt the edges of the tires get very little chance to grip. Much weight on the rear wheels is the best preventive of skidding.

WHY SOLID TIRES BOUNCE

Bouncing is another matter. Solid tires are not so deep as pneumatic. They would be very expensive if made so deep and large. While solid rubber is not so resilient as is the air tire, its action is quicker because of its lesser depth. In other words a much smaller movement of the wheel compresses it to its limit and starts the wheel up away from the ground. As a result of this action the solid tire vehicle bounces off the road at speeds far below those at which the air tire will be holding smoothly. My experience was that a well sprung motor buggy riding as easy as if air-tired at speeds below 18 miles per hour on ordinary macadam roads would bounce badly at speeds of 20 to 25 or 30.

RESILIENCY IN TIRES

Just what the effect of a slow tire would be, as proposed by O. W. H., I am not prepared to say, but who would want such a tire? Certain tires on the market now will give 10 per cent. to 25 per cent. more mileage per gallon of fuel than others because they are more resilient, and their use is certain to extend. In the cycle days when human muscle was our motor we woke up on this subject early and built resiliometers to actually measure the difference in different tire constructions. All tires that compress in action absorb power as they compress and unless perfectly resilient they do not give all this power back as they resume their shape behind the point of contact. This difference is very noticeable in certain tires. In the last five mile race at the R. I. State Fair in 1896 our vehicle was fitted with single tube pneumatics. Being a gasoline car it could not start from the tape as fast as could the electrics. It was therefore fully eight rods behind at the quarter, at which time all the cars seemed to have found their gait. It gained steadily on the others after this, clearly showing greater speed, and had almost caught the leader when on the back stretch where it could be plainly seen, it slowed perceptibly. Inquiry showed that at this point a valve tube had been cut off and let the air out. The stiff single tube tire required much power to compress it but gave out practically none as it resumed its shape. We lost the race. Users who wish economy must use not only light vehicles but light tires and must not hope to have them puncture proof but must get safety by quick repairs or replacements.

Philadelphia, May 10, 1915. CHAS. E. DURYEA.

Mr. Duryea's views on skidding and bouncing, in so far as here expressed with reference to the difference between air tires and solids, are so clearly and tersely worded that nothing more need be said, apparently. But at other points a few somewhat dissenting comments may contribute to a sharper focusing of the essentials. In comparing bicycles with automobiles, the peculiarities of bicycles are not negligible. They list readily to either side, which eases shocks, and the road is picked for them. Large obstacles, which are the only ones producing marked horizontal effects, are not struck, as a rule. The steering post has a decided rake. The load is light and the inflation of tires low. The axle is not articulated. With such important differences in construction and conditions a parallel is not convincing.

Duryea's Point Widely Recognized

Better than the analogy with bicycles, therefore, the mechanical fact that a pivot with the outward and forward rake directs shocks to the end of the fixed axle instead of to that short pivoted portion upon which the steering acts, sustains Mr. D.'s argument. It is not uncommon, however, to aim the pivot to the middle of the tire tread, and this is the feature which saves the steering gear. Many wheel spindles are inclined for this purpose. To aim the pivot forward gives the self-steering properties in higher degree, when not exaggerated, but this feature, too, is found recognized here and there. While these arrangements reduce the turning moment against the steering gear connections to nil or to a minimum (since in heavy cars it is necessary to disk the wheel, too, to accomplish the purpose completely) they do not ease the force of shocks or of the horizontal component of a shock against the pivots and the vehicle as a whole. In the case of heavy vehicles it may be questionable if it is more advisable to throw the whole brunt of the shock upon the end-bearings of the pivot, as Mr. D. prefers, or to take up a part of it in the coil springs of the steering connections and even in the steering gear or the arms of the driver.

Walking Speeds Unimportant

In the matter of the Victor bicycle, the supposition of not having enough momentum to carry the vehicle over the obstacle is scarcely of interest, as shocks of such mildness endanger nothing in the case of automobiles. Also, it is not contemplated to make automobile axles "perfectly free to yield fore and aft." On the contrary, if a slight rake of the spring action is provided to take care of the small horizontal shocks, which affect comfort, any springing to permit the axle an additional horizontal movement, can be exceedingly stiff, being used almost exclusively for safety in emergencies. The composite wheel previously described may eventually, however, be found to afford a better method in the case of heavy vehicles, though at present it may appear as a too radical departure from customary expedients.

The action described as the best by Mr. D. is no doubt desirable, though many designers seem much in favor of a purely vertical axle movement, but it is less efficient the higher the speed and the harder the tires; that is, it affords less yielding the more yielding is needed.

Resiliency Only Incidental

"Certain tires," D. says, "will give 25 per cent. more mileage per gallon of fuel than others BECAUSE they are more resilient ....." The BECAUSE seems arbitrary, even if the tires referred to are in fact more resilient. The reason for saving power by using them might be that their resistance to flexion is smaller, and not that they extend with nearly the same force that is spent in flexing them. It is possible to imagine a tire flexing with small resistance yet resuming its shape slowly.

Mr. D. seems to believe that the power absorbed in flexion is returned by a resilient tire in form of help for the propulsion, but the saving effected is really due to the smaller acceleration of masses which the tire flexing with small resistance makes possible; the vehicle body, for example, is moved less and less rapidly. But the extension of the tire to its normal shape returns no power in a useful manner. This objection also covers Mr. D.'s rapid conclusion from his racing experience in 1896. The flat tire had to be flexed all the way round, yet saved no load lift or acceleration.

—

Ball Bearings in Theory and Practice
Part II

(*Continued from page* 899)

Don't hammer the races of a ball bearing with a hard hammer. They are hardened and toughened steel, and treatment of this character can very readily result in a cracked or dented race or very often it will result in flattened balls.

Don't tamper with the locks provided by the car builder—they are provided for the express purpose of keeping you from making adjustments.

When in doubt, communicate with the bearing manufacturer or his qualified representative.

In view of the fact that you are all primarily interested in electric vehicles, it has occurred to me that it might be well to specify where ball bearings are used on "electrics." Doubtless many of you already possess this information, but for those who do not, it will prove interesting.

On all types of electric vehicles, whether chain, bevel shaft or worm shaft drive, ball bearings are used in the wheel hubs, on the armature shaft of the motor and on the differential.

On the chain drive they are used on the jackshaft alongside of or directly under the driving sprockets.

On the bevel shaft drive cars, ball bearings are used back of the bevel pinion and on each side of the bevel gear on the differential.

On the worm shaft drive cars, ball bearings are used on the worm shaft and on each side of the worm wheel on the differential.

It is hardly necessary for me to point out how important ball bearings are in the operation of an electric vehicle They reduce the friction at all bearing points to a minimum and allow maximum mileage to be secured from the battery capacity available.

—

Willard's New Office Building

CLEVELAND, O., May 15—The new office building of the Willard Storage Battery Co., this city, is an example of what can be done to increase the efficiency of employees by careful attention to their comfort and the development of interdepartment relations. Formerly the offices were a mile from the factories.

Among the features of the building are a large dining room where employees are served at noon, experimental laboratory and a photograph gallery.

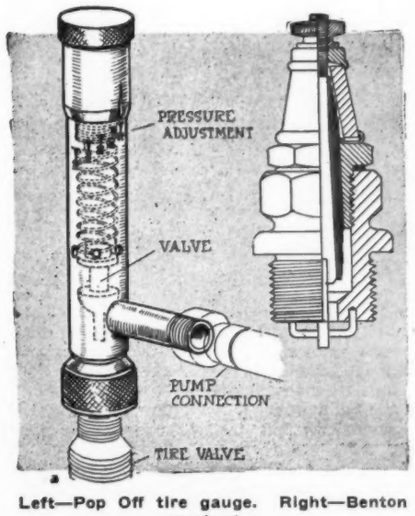
This brick and stone building is 150 by 30 feet and has been occupied 6 weeks. It is one of ten structures with 6 acres of floor-space which the company is erecting.

ACCESSORIES

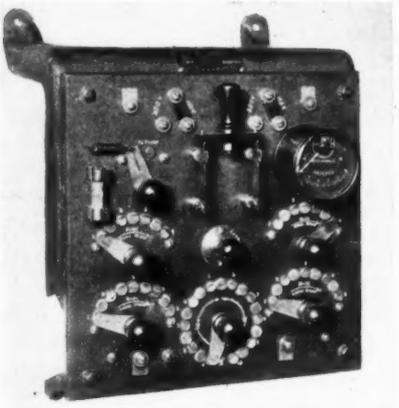
Small Westinghouse Rectifier

TO eliminate the waste of energy in resistances for cutting down the voltage in large motor generator sets or direct current supply circuits for battery charging, the Westinghouse company has brought out a small mercury rectifier charging outfit called modified type E, illustrated herewith, specially designed for public garages which have a number of lighting and starting batteries to charge every night. Similar outfits for the car owner who desires to charge one or two batteries are also available.

The device consists of a cast iron wall bracket carrying a small slate panel for the switches and connections, the mercury bulb being mounted behind the panel for protection. A knob on the front tilts the bulb for starting. Back of the bulb and mounted on the bracket are the transformer and reactance coil. The outfit charges one three-cell battery at a time or a number of them in series. Provision is also made for charging one or two single cells, which is very advantageous if one or more low ones are to be charged. Adjustments to suit the number of cells to be charged are made by changing the transformer connections and no energy is wasted in series resistance. It is easy to adjust for a tapering charge such as is suited to lead cells or for the more constant current which is best for charging the Edison type. In both cases the outfit need not be touched after the charge has been started. When the series system is used each battery is disconnected as it becomes fully charged



Left—Pop Off tire gauge. Right—Benton spark plug



Upper—Westinghouse large capacity type E 5 and 10-ampere mercury vapor rectifier
Lower—Type E 10-ampere rectifier outfit

and the charge continued on the rest with a lower dial setting because of the smaller number. Provision is made for mounting a D. C. ammeter on the panel when desired.

Both 5 and 10-ampere outfits are designed for operation on either 110 or 220-volt, 60-cycle circuits. Link connections adjust the outfit to suit either voltage.

At a 5 cents per kilowatt-hour rate, the 10-ampere outfit costs .012 cent per hour for current to charge six cells, .025 cent for eighteen cells and .048 cent per hour for thirty-six cells. Using the 5-ampere outfit the hourly cost for current is correspondingly reduced.—Westinghouse Elect. & Mfg. Co., East Pittsburgh, Pa.

Pop Off Tire Gauge

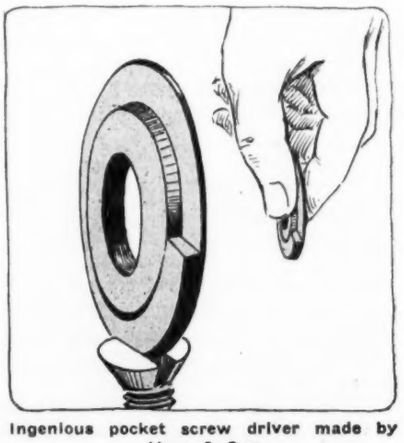
The gauge illustrated herewith is designed to automatically insure the correct pressure in a tire and to prevent accidents due to inflating casings beyond their strength. The indicator is set for the desired number of pounds pressure and when this has been reached the valve in the gauge automatically closes and no more air can be forced into the tire, while the operator is warned by the air escaping through the holes in the gauge. In applying the gauge it is screwed to the nipple just as the pump is ordinarily attached and the pump is screwed to the L-pipe on the gauge, this having the standard nipple thread. The gauge may be left attached to the pump, if desired, rendering it necessary to make only one attachment. The device is said to not only prevent over-inflation or under-inflation, but also to result in a considerable saving of time in that no testing and adjustment of gauge and air pressure are necessary. With the Pop Off gauge any pressure from 50 to 110 pounds may be secured. Price, $1.00.—American Sanitary Lock Co., Indianapolis, Ind.

Benton Spark Plug

The plug shown in the illustration is claimed to minimize common defects in spark plug construction, to resist fouling and to permit easy cleaning. The insulator is thin sheet mica spirally wound upon the central electrode and forced to a permanent gas and oil tight joint within a steel bushing. The mica above the bushing is inclosed in a porcelain spacer which could be cracked or entirely removed without short-circuiting the plug.

The insulator is easily removed for cleaning by unscrewing a single joint, when the insulator surface may be washed with gasoline or scraped with a knife. This also facilitates adjustment of the spark gap. Frequent cleaning has no detrimental effect on the fit of the joint. Battering of thread surfaces, etc., is prevented by case-hardening.

Te prevent overheating of the insulation the center electrode has greater cross-section than the mica insulation itself and offers a large body of metal to rapidly conduct the heat through the plug to the air. The wire used in the electrode terminals is a special composition which is said to neither fuse nor cor-



Ingenious pocket screw driver made by Hess & Son

Adco shock absorber, showing peculiar shape of central member

rode, the outer wire forming the spark gap being bent in a semi-circle around the central electrode to give the spark a wide selection of points.

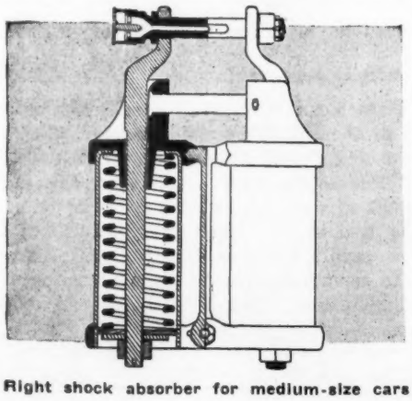
The internal passages of the plug are designed so that exploding gas blows away from the insulator much of the carbon that would otherwise be deposited on it. The plugs sell for $1 each, a special set of four for Ford cars being furnished at $3.—L. F. Benton Co., Vergennes, Vt.

Pocket Screwdriver

One would not recognize the article shown in the accompanying illustration as being a screwdriver, yet it acts as such with great facility. Though only an inch in diameter, the power is quite surprising and it is possible to move quite a large screw. Owing to the edge being of varying thickness, one can choose the point on the circumference that best fits the slot in the screw head which prevents slipping and helps the action. Even without putting anything through the hole to act as a lever the power is enough for lots of the small screws on an automobile, and with a 3-inch nail used as a tommy bar one can move screws in wood up to 2 inches long. The price is 10 cents.—Hess & Son, Philadelphia, Pa.

Rigid Ford Shock Absorber

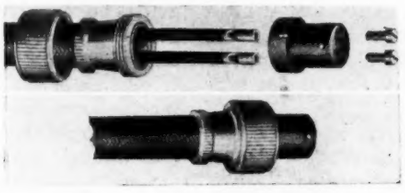
The Adco is a simple coil spring shock reducer which has as its special feature great area of all moving parts, and exceptional durability is therefore claimed for it. The sketch shows the substantial flat section coil spring and the peculiar shape of the central member. It is pointed out that this section gives a very large wearing surface and that it also provides great lateral rigidity. Because of this it is asserted that the addition of a set of Adcos to a Ford car in no way reduces the lateral rigidity of the suspension; rather to the contrary in fact. There is a manganese bronze bushing in the swivel pin end of the center piece. Two can be obtained for $8 to fit either front or rear springs and the full set of four costs $15.—Auto Device Mfg. Co., Milwaukee, Wis.



Right shock absorber for medium-size cars

Shock Absorber for Medium Heavy Cars

The "Right" shock absorber of supplementary spring type is designed with a travel of 2 inches, which is sufficient to enable it to deal with quite violent bumps. The construction is very simple and the parts strong, the piston being vulcanized fiber. This material has the advantage that it cannot rust or corrode and needs no lubrication. Practically the only part liable to wear is the steel bushing at the top of the cylinder and this is arranged so that it can be renewed easily and at very small cost. The outfit is proportioned to suit cars of medium size, and sells for $15 the set.—Right Motor Specialties Co., Chicago, Ill.



National terminals for Ediswan type lamp fittings

Utility Tire Grips

The Utility Auto Shoe is a spring steel strap with waterproof webbing strap attachment that can be secured to a tire either to give a driving grip in heavy mud, to act as a strengthener of a weak spot in the shoe, or to hold a blowout patch. Eight are supplied in a set, and the steel portions are 1-16-inch thick by 1 3-4 inches wide. The illustration explains the device completely. Obvious good points are the small space taken in the kit and the ease of application. The cost of a set is from $4.50 for 3-inch tires to $6 for 5-inch tires.—Franklin Auto Shoe Co., Pendleton, Ind.

Light-Weight Woodworth Tread

The light-weight Woodworth tread has been placed on the market with many advantages claimed for it over previous types of tire protectors, one of which is lower price. The tread is of special process leather said to give nearly double the durability of the best chrome-tanned hides under abrasive wear. It is of one-ply of leather, and has three to six rows of steel studs according to the size. Coil springs 3 inches long placed about a foot apart and connected by elastic fabric strips hold the protector tightly on the tire, as illustrated, preventing chafing and over-heating. The leather is waterproof and flexible and is said to have no noticeable effect on the power or riding qualities of the car. The light-weight treads list at $6.90 each for 30 by 3 1-2-inch tires, $9.70 each for the 34 by 4 size, other prices being in proportion.—Leather Tire Goods Co., Niagara Falls, N. Y.

The new light-weight Woodworth tread mounted on wheel

National Electric Fittings

The use of flexible tubing together with junction and switch boxes has shown a marked increase since the development of electrical systems for automobiles. The terminals for Ediswan type lamp fittings, illustrated herewith, are easily wired and strong. These terminals are made in all sizes in single and double contact types and are designed to be used in connection with the various types of flexible metal and insulating tubing produced by the National company under the names of Autoflex, Tube, Special Flextube, Auto Steelflex and Auto Brassflex. The terminals sell for 65 cents each. The company also manufactures a complete line of junction boxes and other materials for automobile wiring.—National Metal Molding Co., Pittsburgh, Pa.

Utility tire grips to prevent skidding or to hold blowout patch

Harding Connecting-Rod Under Tension

Two-Cycle English Design Has Double Truncated Pistons —Uses No Crankcase Compression

A TWO-CYCLE engine which has several features of originality has been described in English papers of recent date. This is the Harding two-stroke motor of truncated piston design, having no crankcase compression and depending on the direct suction produced above the piston for bringing the charge into the cylinders and also producing a pure air current for scavenging purposes. Probably the most remarkable feature about the entire engine is that the connecting-rod is under tension instead of compression on the power stroke.

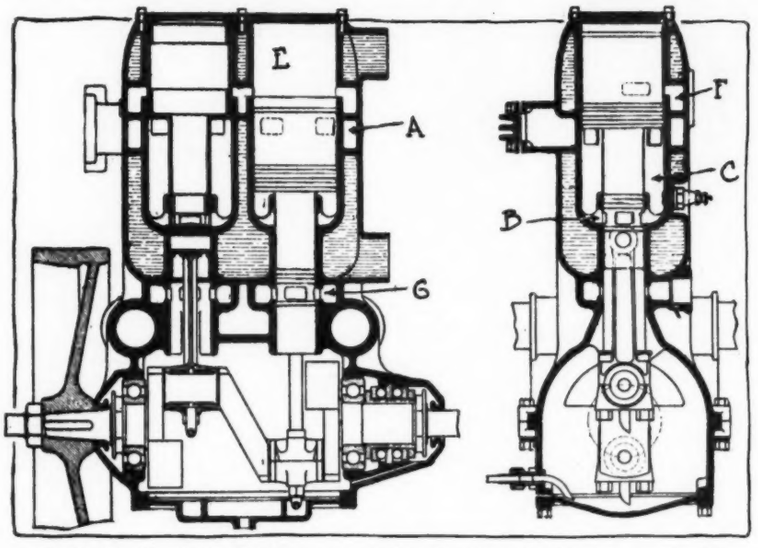


Fig. 2—Longitudinal and transverse sections through Harding two-cycle motor, showing double pistons and ample water jackets carried well down on the cylinders, as the explosion takes place beneath the pistons

Referring to the drawings, the motor is shown in different parts of the cycle in Fig. 1. As will be noted, the pistons are double, making an aperture or volume between the piston and the wall of the cylinder. It is in this space that compression and explosion take place, the piston being forced upward by the pressure against the annular surface of the upper part of the piston.

Assuming the gas to be under compression as at the left of Fig. 1, and the motor at the last of the exhaust stroke, the exhaust gases are being forced out the passage A while the intake gases are entering the annular space from the interior of the piston through B. As the piston descends the ports A are closed by the upper wall and the gas is being compressed in the space C. When firing occurs, the gas is fully compressed as at B and at the same time a vacuum exists above the piston at E allowing gases to enter from the carbureter through the port F. At the same time pure air is drawn in through G at the bottom extremity of the piston and on exhaust this air materially helps in scavenging.

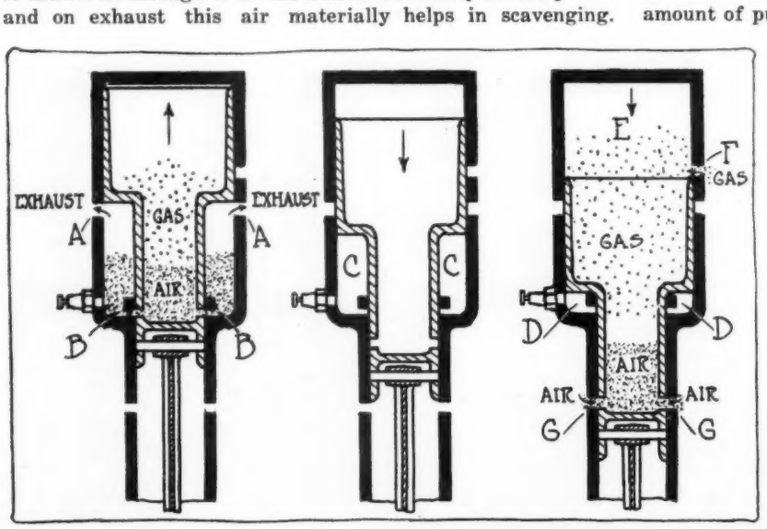


Fig. 1—Illustrating the two-stroke cycle of the Harding motor, showing use of air for scavenging

It is aimed by this system to overcome the two great difficulties in two-stroke design, the proper scavenging and the proper intake of the next charge. The scavenging is taken care of by the introduction of the fresh air and the proper introduction of the succeeding charge is taken care of by eliminating crankcase compression and having the flow of gas directly from the carbureter. In working out this result several unusual features are found. The first is that the explosion takes place below the piston, thus forcing it upwards, and at all times in the cycle there is more pressure below the piston than above it. The result of this is that the connecting-rod is always in tension and never under compression.

No Baffle Plate Required

It is usual in standard two-cycle practice to find a baffle plate used to properly distribute the charge but with this motor none is necessary. In arranging the scavenging amount of pure air can be controlled and the air and the gas sweep through the entire length of the combustion chamber. A great exhaust area can be procured by making the ports at the top of the stroke as large as desired and since the diameter of the cylinder is greatest at this point it is stated three times the usual exhaust area can be obtained. This allows the timing to be such as to utilize fully the expansion.

Pistons Easily Removable

The pistons can be removed directly through the top of the engine by simply removing the top plate and drawing them out. The objections offered to the motor are its increase in the weight of the reciprocating parts and the pumping loss in the upper cylinders. Those who have seen the engine, however, state that these are compensated for by the advantages in scavenging and introducing the charge and also under test a speed of 200 r.p.m. with steady running was reached without the semblance of a miss.

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A Foretaste of Speed

WITH the stage not even set for the speed classic of 1915 at Indianapolis and with some of the entrants to the race still far from the scene of the event, indications are already being made by the contestants upon the ground that the highest hopes for the high-speed, low-displacement power plants are coming into their own.

Speeds greatly in excess of the records of 1914 are being unofficially announced from day to day as the drivers in their early morning trials force their mounts around the 2.5-mile circuit and new cars which have heretofore never put a tire upon the surface of a racing track are outshining the best efforts of previous designs with motors 50 per cent. larger in piston displacement.

The lesson to be drawn from this is not yet complete and will not be until the test of the long 500-mile grind has shown the world whether or not the hopes of the small displacement motor have been realized. With higher rotative speeds it naturally follows that the greatest possible strength must be supplied by the bearings, the reciprocating parts and especially parts subject to the great strains of alternate stresses. What is done in one lap may not be done in 200 laps and yet, looking backward over the progress of events during the past 4 years and tracing the curves of development during this period of time, the machines we have today stand as the logical continuation of these curves over the course which seems most reasonable if their plotting were to be continued.

Yet, every curve has its peak, and if this year shows another point in the onward course of this curve without the slightest sign of a falling off in efficiency of speed, power or endurance we will go a step beyond until finally the peak or maximum point is reached. The varied nature of our entries this year is calculated to furnish us with this information better than ever before.

The Michigan Law

NEXT January, Michigan will have a new automobile tax law which provides a horsepower tax plus a fee for each 100 pounds of weight of car. Detroit fought it, and naturally many manufacturers of cars fought it. But it went through, and it means a material increase over the $3 now charged for registration.

As Michigan is one of the states with a large automobile registration, it is looked upon as representative so far as automobile laws are concerned. Undoubtedly if the new law works out satisfactorily, other states will copy it. In the long run, though the new tax seems large, it will prove less than the automobilist now pays, for by its provisions, he is exempted from any other city, county or state tax on the vehicle. Now a personal property tax is levied in addition to the $3 registration fee. The money will be used for road development.

Engineers believe that should the law be widely adopted, it would have a great influence in the promotion of lighter cars, and smaller-bore motors.

The solons at Lansing did not know what they were doing for the automobile industry when they made the law, and though it may seem oppressive just now, it will undoubtedly prove a far reaching influence in time, if it is adhered to without amendment. It will give the state better roads, promote lighter motor and chassis design, and boost the small high-speed engine.

Automobiles Solve the Problem

LAST week Detroit was treated to a street car strike which lasted for about 48 hours. The solution of the transportation problem was the automobile and the strike was treated more as a new experience by the city than as a real calamity. Everybody who owned a car pitched in to help out, and before the tie-up was many hours old an army of cars was transporting humanity to and fro about the city, so that business was not held up.

Doubtless the street car men and the traction company officials saw the writing on the wall, for they made haste to call it all off. It would not have required many days for Detroiters to have become thoroughly accustomed to the army of jitney buses that came into being with marvelous rapidity, when the full importance of the tie-up became apparent.

Detroit has undoubtedly proven that street car strikes are a thing of the past.

Dunn Is Overland Vice-President

President of Fisk Rubber Co. Acquires Interest in Toledo Firm—Is Director

TOLEDO, O., May 18—*Special Telegram*—Harry T. Dunn, president of the Fisk Rubber Co., Chicopee Falls, Mass., since its inception, has become vice-president and a director of the Willys-Overland Co., this city, in which he has acquired an interest, and in the future will devote the major portion of his time to that organization.

It was under Mr. Dunn's leadership that the Fisk Rubber Co. attained its present prominence and prestige in the tire industry. His connection with the Willys-Overland Co. accentuates his long friendship with John N. Willys, the rapid growth of the company and the plans which Mr. Willys has formulated for its development being responsible for the present arrangement.

Personnel Unchanged

The present personnel of the Fisk Rubber Co. and of the Willys-Overland Co. will remain unchanged.

—

1916 Oaklands Lower in Appearance and Price

PONTIAC, MICH., May 20—This week the Oakland Motor Car Co., this city, makes public the details of its four-cylinder model for 1916, which is the successor of model 37. It is designated as model 38, and is to sell at $1,050 in either roadster, touring car or speedster type. This price is $150 lower than the previous model's touring car, and $100 less than that of the model 37 roadster.

The general design of chassis and bodies is the same as formerly. By redesigning the clutch, the power plant has been shortened 2 inches, making a more compact unit.

Outwardly, the radiator, hood and cowl have been raised 1 inch, which adds to the lines of the car. In the driving compartment, more room has been secured by deepening it is so as to give 2 inches more leg space. It also has been widened 2 inches. Due to these changes, the car has a larger front appearance.

Other body details that have come in for revision are the replacing of the former metal running boards with the linoleum-covered variety, while a neat combination of the metal instrument board with the body—also of metal—lends to the appearance in this particular.

The Oakland motor is of Northway make, and is a 3 1-2 by 5 detachable head, block type, with clutch and gearset in unit. The Stewart vacuum feed is retained, as also the Marvel carbureter and Delco combination ignition, starting and lighting system. The attractive V-shaped radiator is also used, and the unique oilless rocker bearings on the brake operating system and the gear-shifting lever are still continued.

The drive is of the Hotchkiss type with tubular propeller shaft. The frame is tapered to follow the lines of the body. Three-quarter elliptic rear springs are underslung from the axle, allowing the car to be low hung—one of its distinguishing features. The wheelbase is 112 inches, and the wheels are shod with 33 by 4 tires all around, non-skids being fitted in the rear.

—

Bollstrom To Market Four-Wheel-Drive Chassis

DETROIT, MICH., May 17—Word comes from Battle Creek, Mich., that the Bollstrom Products Sales Co. of that city is to start delivery in November of a four-wheel-drive motor vehicle which is the design of Maurice Bollstrom, pioneer in the four-wheel drive type of vehicle. He has designed a chassis of 1-2-ton capacity, which will be used as the basis of either roadster, touring car or delivery car.

The Bollstrom concern is not to make the vehicles itself, but states that it has closed a contract with another firm to do the actual manufacturing for it. It also is asserted that agencies are now being closed for the future product, having already made selling connections in some of the larger cities.

—

Big Race at Sheepshead October 2

NEW YORK CITY, May 15—Although nothing definite has been announced it is generally understood that the Sheepshead Bay motor speedway will be opened on October 2 by a big race, the details of which have not as yet been announced. Work is progressing rapidly on this speedway at the present time. Seven hundred men are at work and three-quarters of the grading has already been completed and 1-4 of a mile of concrete sleepers which will support the track on the straightaways are in place. The steel work which will carry the wood track on the bankings is coming through on schedule and it is expected that the entire supporting frame work to carry the track will be ready so that the laying of the wood surface can begin June 15.

Three new names in the motor industry have been added to the list of stockholders, these being Windsor T. White and Walter White of the White Co., Cleveland, and R. D. Chapin, president of the Hudson Motor Car Co., Detroit.

Wilson Re-Elected A. A. A. Head

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Delegates from 20 States Vote for Uniform Tax, Federal Aid and Tour Bureau

BOSTON, May 18—The annual meeting of the American Automobile Association was held here yesterday and today, and it was attended by delegates representing twenty States. President John A. Wilson called the meeting to order yesterday morning and the forenoon session was given over to reading reports of committees on what had been accomplished during the year. This was followed by the election of officers and there was no opposition to the names brought in by the nominating committee. President Wilson was re-elected amid a tumult of applause. The other officers chosen were: H. M. Rowe, Maryland, first vice-president; Ralph W. Smith, Colorado, second vice-president; P. J. Walker, California, third vice-president; H. J. Clark, Minnesota, fourth vice-president; Preston Belvin, Virginia, fifth vice-president; John A. Brooks, Connecticut, secretary; H. A. Bonnell, New Jersey, treasurer; A. G. Batchelder, New York, chairman executive committee.

At the afternoon session the main discussion centered about a resolution presented by Charles Thaddeus Terry, of New York, on double taxation, reading as follows:

"Whereas, The motor-driven vehicle has become the common means of transportation, commercially and socially, that it enters into every progressive phase of human existence, and should no longer be considered as a special means of travel; therefore be it

"Resolved, That the American Automobile Association through its National Legislative board contends, in the several States and in the Congress and courts of the United States, for a uniform method of taxation, which shall recognize the fact that an automobile should now be included in a general property classification and taxed only as personal property, that no other tax whatever shall be imposed either in connection with the vehicle or its operation, expect a nominal registration fee covering only the clerical cost of the issuing of an identification number for the vehicle and its operator in order that the police powers of the State or municipalities may not be impaired."

Ex-President Lewis R. Speare, representing Massachusetts, opposed the resolution and said that Massachusetts was satisfied with its law even though it were costing Bay State motorists more than $1,000,000 a year. Some of the other speakers did not seem to get the drift of

the resolution, but H. M. Rowe, of Maryland, made the most convincing speech in favor of it, after which it was easily passed by a voice vote. Three other resolutions were offered and passed, one pledging the confidence of the association in President Woodrow Wilson in the present international crisis; another on federal aid for highways, and the third for a bureau of tours under national government supervision. All were passed unanimously.

There were rumors of a fight to have the New York headquarters moved to Chicago, and also to have the Washington headquarters closed, but there was perfect harmony when the matter came up and no changes made. Dallas and Cleveland wanted the next meeting, but the executive officers had picked out Washington and that settled it, so it was voted to go to the national capital. It was also voted to change the fiscal year to a later period. The annual report showed a good balance in the treasury. A number of new clubs were voted in and there are now 139 such organizations on the rolls.

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N. Y. 50,000 Cars Ahead of 1914

NEW YORK CITY, May 17—New York State automobile registrations have gained 50,000 over 1914, that is, in the period included between February 1 to May 8. The actual number of registrations is 168,428 from February, 1914, to the same month in 1915, and 169,598 in the period included between February, 1915, to May 8, 1915.

Registration Feb. 1-May 8.

	Owners	Chauffeurs	Fees
New York office.....	73,193	42,699	$678,644.50
1914	57,269	37,557	593,864.25
Gain	15,924	5,142	$84,780.25
Buffalo office	54,168	8,574	414,426.50
1914	34,393	6,233	289,546.00
Gain	19,775	2,341	$124,880.50
Albany office.....	42,237	8,157	322,387.00
1914	27,311	6,202	234,313.00
Gain	14,926	1,955	$88,074.00
Total 169,598		59,430	1,415,458.00
1914 118,978		49,992	1,117,723.25
Gain	50,620	9,438	$297,734.75
Total, 1914.			
Feb.-Feb., 1915.....168,428		67,170	1,533,367.86
Feb.-May 8, 1915.....169,598		59,430	1,415,458.00
	Gain 1,170	Loss 8,740	Loss *$118,909.86

*Loss of $71,315 due to half rate provision, recently abolished.

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May Build Eight in Reading

READING, PA., May 18—Eight-cylinder cars may be manufactured in this city in the near future. A company here, which is not yet incorporated, has been negotiating with parts makers for the parts and equipment for a medium-priced eight-cylinder car. It expects to manufacture 500 the first year.

Considerable headway has been made with its plans and test cars will be on the road in a month.

90 M.P.H. in Speedway Practice

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Cooper's Stutz Covers 40 Miles in 26:28—Schebler Adds $2,000 to Cash Prizes

INDIANAPOLIS, IND., May 16—Earl Cooper, the Californian who captured the American road racing championship in 1913, has hung up the best practice record to date, but before the sun sets to-morrow his feat may be eclipsed as there are several cars now being worked out on the track that already are in the pink of condition and showing a world of speed in two and three circuits of the oval.

Cooper established his practice record this afternoon. At the wheel of one of the new Stutz entries, he covered 40 miles in 26 minutes 28 seconds, a speed of 90 1-2 miles an hour. His fastest lap was 1 minute 37 seconds and his slowest 1 minute 42 1-2 seconds.

Although the Stutz is a native product and very popular with local fans, the foreign cars are not without their favorites and will be heavily backed. Resta's Peugeot looks especially dangerous, and the winner of the 1915 Vanderbilt cup and grand prize is driving the track as if he knew every brick of the 3,500,000 with which it is paved.

John de Palma, Ralph's brother, who will make his début as a big league driver at Indianapolis May 29, has overhauled the Delage that carried Thomas to victory last year, and the motor of the French car has a most menacing roar. The two Sunbeams, entered by the English maker, had not shown much until today. The drivers, Porporato and Graham, have been working on them all week, and in practice this afternoon were circling the track at a 90-mile-an-hour clip.

De Palma arrived from Detroit yesterday morning. He unloaded his Mercedes, drove it to the speedway under its own power and without lifting the hood, covered a lap at a speed of 90 miles an hour on his first trial. He spent today experimenting with tires of different sizes. He already has decided on his gear ratio, and to obtain sufficient engine revolutions to insure maximum power must use 33 by 4 1-2 casings. Changing the tire sizes is an alternative to changing the rear axle gears.

Three of the three-car teams, Duesenberg, Bergdoll and F.R.P., have not arrived as yet, but they are expected the first of the week in order to prepare their machines for the elimination trials that are scheduled for Thursday, Friday and Saturday. The following cars already are quartered at the speedway:

Cars at the Track

The three Maxwells, Ralph de Palma's Mercedes, Graham's Sunbeam, Porporato's Sunbeam, Cornelian, John de Palma's Delage, the three Stutzes, the three Peugeots, Oldfield's Bugatti, Sebring, Grant's Sunbeam, Limberg's Sunbeam, the three Mercers, the Burman Special, the Harroun Special, Klein's Kleinart and the Mais Special.

The three Mercers, counted on to regain the championship lost to France in 1913 and 1914, have not been seen in action as yet. The cars did not arrive

List of Entries for Indianapolis 500-Mile Race

Car	Driver	Entrants
Maxwell	Carlson	Maxwell Motor Sales Corp.
Maxwell	Rickenbacher	Maxwell Motor Sales Corp.
Maxwell	———	Maxwell Motor Sales Corp.
Mercedes	De Palma	E. C. Patterson
Sunbeam	Porporato	Louis Coatalen
Sunbeam	Graham	Louis Coatalen
Du Chesneau	Brown	C. A. Du Chesneau
Duesenberg	Alley	F. S. Duesenberg
Duesenberg	O'Donnell	F. S. Duesenberg
Cornelian	Chevrolet	Blood Bros. Machine Co.
Delage	J. De Palma	J. E. Wilson
Stutz	Anderson	Stutz Motor Car Co.
Stutz	Cooper	Stutz Motor Car Co.
Stutz	Wilcox	Stutz Motor Car Co.
Peugeot	Resta	Peugeot Auto Import Co.
Peugeot	Bragg	Peugeot Auto Import Co.
Peugeot	Babcock	Peugeot Auto Import Co.
Bergdoll	E. Bergdoll	G. C. Bergdoll
Bergdoll	J. Bergdoll	G. C. Bergdoll
Mercer	Pullen	Mercer Automobile Co.
Mercer	Ruckstell	Mercer Automobile Co.
Mercer	Nikrent	Mercer Automobile Co.
Bugatti	Oldfield	C. W. Fuller
Bergdoll	Haupt	G. C. Bergdoll
Emden	Donaldson	R. E. Donaldson
Porter-Knight	Hughes	F. R. Porter
Porter-Knight	Keene	F. R. Porter
Porter-Knight	Whalen	F. R. Porter
Sebring	Cooper	E. E. Miles and J. W. Gwin
Sunbeam	Grant	Fortuna Racing Team, Inc.
Sunbeam	Limberg	Fortuna Racing Team, Inc.
Cino-Purcell	Cox	W. R. Purcell
Burman	Burman	Bob Burman
Harroun	Orr	Ray Harroun
Mulford	Mulford	Luther Brown
Cino	McNay	E. D. McNay
Kleinart	Klein	E. E. Klein
Mais	Mais	J. A. Mais
Duesenberg	———	F. S. Duesenberg
Shambaugh Spec.	Shambaugh	Charles Shambaugh
Bals Special	Hill	N. B. Bals

from Trenton, N. J., until late this afternoon and were not unloaded in time to participate in the Sunday practice.

The Maxwells made their first appearance this afternoon. Barney Oldfield warmed up one of Ray Harroun's latest speed creations, but could not get much speed out of it because it was new and consequently stiff. There is a remote possibility that Barney may drive a Maxwell. Two of the cylinders on his Bugatti are cracked and unless he can have new ones made here and get the German car in shape for the gruelling grind, may switch. After testing the Maxwell this afternoon, Oldfield suggested several changes that he wanted made in the car, and after this work has been done, will take it out again.

Two cars as yet are without drivers, the third Duesenberg entry and the third Maxwell. The Peugeot team has been completed by the signing of Caleb Bragg last week to take the car in which Galvin overturned in practice, injuring its driver and mechanic so badly that they will not be in shape to participate in the chase for the $50,000 in prize money. Percy Graham, who was sent from England to be Porporato's team-mate in the second Sunbeam, is an English sportsman who has participated only in amateur events on the Brooklands track. He was substituted for Jean Chassagne, who could not make the trip because of a rush of work on war material at the Sunbeam factory. Joe Cooper, an unknown, will be at the wheel of the Sebring.

Wheeler & Schebler Offer $2,000

Wheeler & Schebler, this city, are offering $2,000 in cash prizes for the 500-mile race to be divided as follows: $1,000 to the winner; $500 to second; $300 to third, and $200 to fourth. These prizes are to be awarded on condition that the Schebler carbureter is used. This brings the total cash prize offers up to $54,300, divided up into $50,000 from the Indianapolis Motor Speedway; $1,300 from the Bosch Magneto Co.; $1,000 from the Emil Grossman Mfg. Co., and $2,000 from Wheeler & Schebler.

Officials Named

The officials for the race have been announced as follows: David Beecroft and F. A. Croselmire, New York, A. A. A. representatives; A. R. Pardington, Detroit, referee; F. L. Edwards, director of contests of the Chicago motor speedway, chairman technical committee, and Tom Hay, Chicago, starter.

The order of the time trials will be in the inverse order of entry, the last car starting first, and the first starting last. This is to give the early entrants a chance to figure on the other fellow's performance, so that he may judge his own accordingly. Three trials will be allowed each man, the best of the three to count.

Governor Night at N. Y. S. A. E.

Two Papers and Committee Report on Governing Motor and Vehicle Speed

NEW YORK CITY, May 20—The meeting of the Metropolitan Section of the Society of Automobile Engineers, held tonight at the Automobile Club of America, was devoted to governors. The program called for papers to be delivered on this topic by Theodore Douglas, of the Duplex Engine Governor Co., Frank H. Trego of the Knox Motor Co., and a report of the Research Committee on Governors by Chairman McCoomb, of the General Vehicle Co. Mr. Trego's paper, entitled The Use of Governors for the Control of Motor Speed in Commercial Vehicles, follows, in part:

The object of a governor for the restriction of motor speed in commercial vehicles is either for the purpose of protecting the chassis or the motor from damage resulting from speed beyond which the governor will not allow the motor to operate.

Governors have so far been produced in such a manner that they will close the carbureter throttle when the motor reaches a given speed, generally ranging from 1,000 to 1,200 r.p.m. It is apparent that the motor, to be all that is desired, must have full power up to the speed beyond which it is not expected to run. Therefore, any governor which gradually closes the throttle as the speed increased would not be successful. A governor is, therefore, required which will snap the throttle closed when the given speed is reached, and they seem to have been built largely along this line, with, however, the objectionable feature of surging as the motor rises above and falls below the point at which the throttle will suddenly close.

Road and Load Conditions

Another stumbling block in the way of successfully governing the motor lies in the fact that road and load conditions will govern the position of the throttle necessary to bring the motor to the speed limit for which the governor is set, and it is safe to assume that without load a slightly open throttle will cause the motor to revolve at 1,000 r.p.m. or more, whereas, pulling a full load it would require a wide-open throttle to obtain the same speed.

In handling freight by motor vehicle it is highly important that the returning empty should be accomplished at a greater speed than the outgoing haul fully loaded. The vehicle should be able to stand a higher rate of speed when empty than when loaded, and, as time enters largely into the cost of transportation, every advantage should be taken of this fact. This, however, is impossible with a governor controlling the motor speed, as the governor will hold the vehicle down when empty as well as loaded.

It has been demonstrated time and again that it is impossible to get a vehicle out of trouble in certain road conditions, as for example, a mud-hole, without the full power of the motor with the assistance of the prompt engagement of the clutch. The action of the governor under this condition is to immediately close the throttle when the set speed of the motor is reached by the driver opening the throttle with a disengaged clutch. Therefore, when the clutch is engaged the load is applied when the throttle is closed and the throttle is not opened until the speed of the motor is dragged down by the load, thus losing greatly its power, due to a decrease in revolutions per minute. This makes it impossible to speed up the motor, engage the clutch, and lift the vehicle forward by a sudden application of power to the rear wheels, and has been the cause of so many drivers removing or disconnecting the governor and some manufacturers of motor vehicles abandoning it entirely. No governor will prevent a driver from driving down hill at a reckless pace, and therefore will not hold down the speed under all conditions.

Restrict Power of Motor

A better scheme than the use of governors is the restriction of the power of the motor beyond speeds which equal the miles per hour it is desired that the full loaded vehicle shall run. In doing this the designer is obliged to allow the vehicle to run faster than this speed when empty or lightly loaded, for the full power of the motor will not under those circumstances be required. On the other hand, why should the vehicle not run faster? Generally, a vehicle designed to carry 10 tons, for example, at 10 miles per hour, ought to be able to run 13 to 14 miles per hour when empty, and I have found by careful designing and experimenting that it is possible to so restrict the power of the motor that a speed of say 15 miles per hour empty cannot be exceeded on a level road and have the peak of the power curve of the motor range between 9 and 10 miles per hour of the vehicle.

It is seen that this vehicle is restricted to the desired speed on the out-going trip fully loaded, but may return for another load at a higher rate of speed. Instant application of full power may also be made when the vehicle is stuck in bad going, a procedure impossible when equipped with a governor.

They have been designing governors operating from the transmission to the throttle of the motor, but there is nothing herein to prevent an ignorant driver from racing the motor at high speed when the transmission is in low gear or neutral, a very dangerous liberty to give the ordinary driver of a truck.

The successful completion of a motor whose power will be restricted after a given speed will require, of course, considerable experimenting. The following points will control the situation:

Controlling Factors

Location of the firing point; valve timing; weight of reciprocating parts; size of intake manifold; size of carbureter; and size of lift of valve.

No hard and fast rule can be laid down which will apply to motors of various sizes and design; therefore, each individual motor will present a problem by itself, but this, however, can be worked out with the aid of a dynamometer.

Advances Made in S. A. Exports

Stable Financial Conditions Due to Large Crops and Firm Market Quotations

NEW YORK CITY, May 17—Conditions throughout commercial South America show a generally strong situation financially, according to the reports of representatives of the National City Bank of New York in that part of the world. From Argentina comes the word that the quantity of corn available for exportation in the current year will be about 5,000,000 tons as compared with but 3,542,000 tons for last year. A vessel which left New York for the Eastern Coast of South America a few days ago carried for Brazil $25,000 worth of printed and advertising matter, $3,000 worth of agricultural instruments, $10,000 worth of miscellaneous machinery. For Buenos Aires this vessel carried $20,000 worth of automobiles.

Business conditions in Argentina in the first quarter of the present year are described by the manager of the Buenos Aires Branch of the National City Bank as showing a substantial improvement and one likely to be of a permanent character. The crops are abundant, the price is high and the supply and price of meat normal. The foreign exports will probably exceed those of any previous year and there is a waiting market for every pound of beef and wool that the country can supply.

Exports from New York to South America in the first week of April was the largest of any week of the war period. They totaled $3,500,000 against a weekly average of about $1,500,000 during the war period. Large quantities of petroleum and petroleum products are being shipped to various parts of the Continent.

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Chicago S. A. E. Section?

CHICAGO, ILL., May 17—When W. H. VanDervoort, president of the Moline Automobile Co., was elected president of the Society of Automobile Engineers last week it was expected that one of the events of his year of office would be starting a section of the S. A. E. in Chicago. For over a year the thought of establishing a section in the windy city has been under consideration. There are not so many engineers in Chicago itself, but the surrounding territory, including such outlying cities as Kenosha, Racine, Milwaukee, Moline, Rockford, etc., brings up the number considerably, so that it is considered there is actually plenty of material for a Chicago section. There are 175 members of the S. A. E. in Iowa, Illinois, Wisconsin and northwestern Indiana.

At the present moment President VanDervoort is canvassing the field with the object of seeing if a Chicago section cannot be made during the present season.

While it might be difficult to have monthly meetings for a Chicago section, there is no reason why meetings every 2 months might not be sufficient at certain seasons in the year. As Chicago is one of the great distributing points for cars it is suggested that during the winter season meetings of an educational nature might be conducted which would be of great benefit to the merchandising department of the motor industry.

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Kelly-Springfield Truck Elects Directors and New Officers

SPRINGFIELD, O., May 14—At a meeting of the stockholders of the Kelly-Springfield Motor Truck Co. a dividend of 4 per cent. on preferred stock was declared.

The stockholders elected these directors: Capt. Marion McMillin, A. P. Lathrop, C. W. Young, E. S. Kelly, J. B. Cartmell, H. E. Freeman, C. L. Bauer, J. L. Geddes, and C. N. Jellisse.

The board organized by electing J. L. Geddes as president; Captain McMillin, vice-president; J. M. McCarthy, second vice-president; G. W. Barden, secretary and treasurer; C. W. Young, assistant secretary, and C. N. Jellisse, assistant treasurer.

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Monarch Reorganized—Plan to Build 3,000 Eights

DETROIT, MICH., May 17—The Monarch Motor Car Co., which started in business about 2 years ago with a capital stock of $30,000 has been reorganized and its capital stock increased to $400,000. Eastern capitalists are backing the company, with incorporation under Delaware law.

R. C. Hupp, who has been president since the concern was started, remains as such. A. F. Spaulding, of Spaulding, McClellan & Co., is vice-president; George B. Turner, formerly of the Bankers Trust Co., New York, is secretary-treasurer. H. D. W. MacKaye has been appointed director of sales; A. A. Lehr, director of engineering and purchases; Walter R. Bamford, production manager; G. J. Conyne, assistant production manager; J. L. Bell, service manager and M. L. Shanks, office manager.

The company is planning to enlarge the plant and to make from 3,000 to 5,000 eight-cylinder cars for the 1916 season. This car with either a seven-passenger touring or a roadster body will be listed at $1,500.

New Transcontinental Record

Stutz Bearcat Covers 3,728.4 Miles in 11 Days 7 Hours, and 15 Minutes

NEW YORK CITY, May 18—At 10.15 this morning a Stutz Bearcat roadster completed the transcontinental trip from San Diego, Cal., to this city in 11 days, 7 hours, and 15 minutes, Erwin G. Baker driving the car the entire distance, and thus establishing a transcontinental record for a single driver as well as greatly reducing the time for a trip between the Pacific Coast and the Atlantic Ocean. The distance covered was 3,728.4 miles. The trip started from San Diego at midnight on the morning of May 7, the route being by way of Phoenix, Ariz., El Paso, Texas, Roswell, New Mexico, Plainview, Plains and Emporia, Kan., Lexington, Mo., Greenville, Ill., Dayton, O., Greenberg, Pa., Philadelphia and New York.

The 2 first days of the trip were the greatest in mileage, the first day to Phoenix being 409.1 miles, and the second day from Phoenix to El Paso, 592 miles. On the third day 6 hours were lost in miring in quicksand in crossing two streams, and only 244 miles were covered.

Mr. Baker, although new in transcontinental motoring, has had considerable experience in transcontinental traveling with a motorcycle, having covered the Coast to Coast trip in 11 days, 12 hours, and 10 minutes by motorcycle. On the present trip he was accompanied by W. F. Sturm, of Indianapolis, as official observer who had the car officially checked out at San Diego, by A. A. A. officials, checked at the night stops with official signatures and seals, and checked at the finish by an A. A. A. representative.

Single Set of Tires Used

The car went through the run with a single set of tires, the same air being in the fronts at the finish. The car is now being given an official examination by the Automobile Club of America. Its equipment included Houk wire wheels, Stromberg carbureter, Bosch magneto, Hartford shock absorbers, A. C. spark plugs, Stewart horn, Prest-O-Lite tank, etc.

Throughout the trip driver Baker and his companion averaged 4 or 5 hours sleep each night, generally driving until 9.30 or 10 and getting away at 4 o'clock the following morning.

The Stutz Bearcat was a standard model, with four-cylinder motor, 4 3-4 by 5 1-2 inches bore and stroke. It was stripped of fenders and carried a wire radiator screen, with the springs taped.

Paige to Double Production

Additions Will Make Output 150 Cars a Day—Methods Improved

DETROIT, MICH., May 17—For the purpose of doubling its production the Paige-Detroit Motor Car Co. will begin the erection of an addition to its plant, to consist of a three-story building 60 feet wide and 500 feet long. This will make it possible to build 150 cars a day or seventy more than the present daily output. The company intends to make 15,000 cars next season.

Considerable new machinery will be installed and the total expense will be $275,000 or more.

Production methods will be improved and one of the features when the new addition is completed will be the installation of a mechanical conveyor.

By this system the integral parts of the car are placed on a moving platform of the endless chain type and part by part is added as the embryo car moves along from one group of workers to another. Thus the rear axle, which was the beginning of the car, will have become a complete car by the time it has reached the end of the conveyor.

The Paige-Detroit company started in business in 1909. Last year it moved into its new plant, the main building being 792 feet long and 60 feet wide. When completed the concern will have one of the largest automobile plants in the country. The first year the total floor-space was 2,400 square feet. At the present time it is 390,000 square feet. When the addition is completed the total will be over 600,000 square feet.

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Higher-Speed Motor in 1916 Lewis VI—New Body

NEW YORK CITY, May 19—A smaller higher-speed motor, detail mechanical changes and body refinements mark the 1916 Lewis VI, whose price remains at $1,600. As heretofore, a single chassis is produced. The motor has been reduced in bore from 3 1-2 to 3 1-4 and the stroke remains at 6 inches. At the same time the gear ratio has been increased to 4 to 1, it being 3 3-4 this year. A new oiling system with leads to the main bearings and silent chain drive has been adopted. The electrical system is a Remy and the timer-distributer is now driven from the pump shaft through a worm gear. It is vertically mounted. The Stewart single-cylinder motor-driven tire pump has been added. It is mounted at the right side of the gearcase and the hose is carried in a compartment in the floorboard.

Flush-sided body with double cowl is a new feature. The instrument board, windshield base and front cowl is a single aluminum casting. The height of the radiator cap has been reduced and the lines of the hood have been rounded considerably.

A six-passenger touring body and two-passenger runabout are mounted on the one chassis. The latter has a collapsible steering gear and a disappearing top. Tires are carried in a compartment at the rear.

The Cutler-Hammer magnetic gear-shift is optional at $150 additional cost.

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Studebakers Enter Export Assn.

NEW YORK CITY, May 14—Clement Studebaker, Jr., G. M. Studebaker and C. A. Carlisle, of the Studebaker Corp., South Bend, Ind., have joined the International Traders, Ltd. G. B. Hanford, general manager of the association, stated that the organization is in a general import and export business and that the recent addition of the Studebaker members did not presage any connection with Studebaker automobile business.

The International Traders was formed last fall, and has gone after business in Europe and South America on a large scale. Although much of the export business has been in war orders, officials of the company maintain they are working more along lines that will develop a permanent movement.

The company has an authorized capital stock of $1,000,000. The directors, besides those named, include G. B. Hanford, J. L. Moon, who is president of the organization; F. O. Seaver, vice-president; E. M. Lowell, treasurer, and E. E. Dawson.

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Used Car Report for Salesmen

CHICAGO, ILL., May 17—A Salesman's edition of the Central Used Car Market Report is to be issued by the Chicago Automobile Trade Assn. It will be of vest-pocket size, 5 by 2 1-2 inches, and will cost $5 a year, appearing in revised and up-to-date form with the regular report every 3 months. Also, a Credit Bureau is planned for Chicago.

The regular report is too large to be carried by a salesman, and the Salesman's Edition is designed to fill this need.

The book will be issued only to subscribers to the larger report, according to present plans.

Co-operation in the used car report service is now being furnished by twenty-seven associations and it is planned to rebate to each $2.50 out of every $5.00 received, this money to be used for the routine work of contributing associations. Revenue from this plan is to be used to establish a credit bureau for furnishing information, court service, etc., to members.

Tax H.P. and Weight in Michigan

New Law Goes Into Effect Jan. 1, 1916—25 Cents Per H. P. and 25 Per 100 Lbs.

DETROIT, Mich, May 15—The new Michigan motor vehicle law will go into effect January 1, 1916. It is a radical departure from the previous law principally because all cars will be taxed according to horsepower and weight.

Briefly stated the principal provisions are:

Gasoline and steam cars will be taxed 25 cents per horsepower and 25 cents per 100 pounds of weight. The horsepower will be computed by the standard S.A.E. formula.

The weight of a motor vehicle will be that of the car fully equipped at which the manufacturer represents it or the weight given in the shipping bill. If not given or known then the weight will be determined on a standard scale.

Electric vehicles will be taxed $1 for each horsepower and 25 cents per 100 pounds.

Motor trucks will be considered those having more than two wheels and only one seat with no provision for other seats and which have been built and are operated for the purpose of transporting articles other than persons.

Gasoline and steam trucks will be taxed 15 cents per horsepower and 15 cents per 100 pounds.

The tax for electric trucks will be 50 cents per horsepower and 25 cents per 100 pounds.

Motorcycles are subject to a tax of 25 cents per horsepower and 25 cents per 100 pounds.

Automobile manufacturers and dealers will pay a tax of $50 for five cars and $10 for every car in excess of five.

All motor vehicles registered after the first day of September in any calendar year will be subjected to only one-half the regular tax rates.

Automobile manufacturers or dealers will not be exempt from paying taxes as personal property on cars in stock or bond except on the specified number that have been registered by them to operate on the public highways.

Any person desiring to operate a car as a chauffeur must register and pay a fee of $2. Chauffeurs registering after August first pay only one-half of the regular fee.

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Farmack Car Enters Field

CHICAGO, ILL., May 18—This city is again breaking into the passenger car field with the announcement of the Farmack car, made by the Farmack

Motor Car Corp., 332 South Michigan avenue. While actual production has not yet begun, it is proposed to build three models using the same chassis. The price of the touring car will be about $750 including an electric starting and lighting system. A cabriolet, and three passenger roadster models also will be marketed. The car as outlined will have a 106-inch wheelbase, four-cylinder, 3 1-2 by 5 valve-in-the-head motor, cone clutch, three-speed gearset, floating axle and 32 by 3 1-2 tires. It will be assembled. The concern states that between August 1, 1915, and August 1, 1916, 5,000 cars will be shipped. This newly formed corporation has as its head A. J. Farmer, who was last connected with the Farmer Mfg. Co., Detroit; vice-president, George H. McKenney, a Chicago physician; secretary-treasurer, M. M. McIntyre. The officers make it plain that no deposits will be accepted until production is under way. The old Staver plant is to be used as a temporary factory.

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Dyneto System for Fords

SYRACUSE, N. Y., May 18—The Dyneto Electric Co., this city, which has been producing single unit starting and lighting systems for Franklin, Regal and other cars, has put out a special outfit for Fords. The motor generator is practically the same as that furnished for larger cars and all the important features which enter into the construction of the larger types have been retained. Current regulation is accomplished by the inherent quality of a compound winding.

The installation is made by means of a bracket which holds the apparatus firmly. It is stated that the entire outfit can be installed in approximately 3 hours by anyone who is only slightly familiar with the use of tools. No drilling or machine work is required. The outfit is sold complete including a Willard battery, battery-box, wiring, switches, etc., with a complete marking system by means of which it is readily possible for anyone to make the installation.

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Moorehouse Is Chief Engineer for Mutual Motors

JACKSON, MICH., May 15—A. Moorehouse has been appointed chief engineer of the Mutual Motors Co., of this city. For 4 or 5 years Mr. Moorehouse has been in the engineering department of the Hudson Co., prior to which time he was connected with the Cadillac.

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N. A. C. C. Annual Meeting June 3

NEW YORK CITY, May 19—The annual meeting of the National Automobile Chamber of Commerce, Inc., will be held June 3, the monthly meeting of the directors being scheduled for June 2.

40 Cents Per H.P. in California

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S. A. E. Rating Used as Basis —All Vehicles Must Carry Lights at Night

SACRAMENTO, CAL., May 12—A fixed registration fee of 40 cents per horsepower, S. A. E. rating, has been adopted by the State legislature during the present session. This new amendment to the motor vehicle act accomplishes an annual saving of about $50,000 by allowing owners to keep their same number plates and re-register them each year. One section of the amendment requires all horse-drawn vehicles as well as automobiles to carry lights at night. The former law taxed automobiles under a blanket rating covering of from 10 to 20, 20 to 30, etc., horsepower.

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Pa. License Raise Defeated

HARRISBURG, PA., May 11—The bill to increase the automobile license fees in order to raise money for highway improvement was defeated in the house last night. This bill, introduced by Rep. Lipschutz, called for an average increase of 25 per cent. on all automobile and commercial vehicle license rates.

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York Men Organize To Build $700 Bell Car

YORK, PA., May 15—The Bell Motor Car Co. is the latest addition to the automobile industry in this city. The new concern will engage in the manufacture of a low-priced car, selling between $700 and $800, and will be incorporated at $50,000. Operations will be started July 1 in the large three-story factory building along the Columbia & Frederick branch of the Pennsylvania railroad and the intersection of Center street, now occupied by the Bailey Mfg. Co., manufacturer of commercial car bodies. It is the aim of the new company to build 1,500 cars the first year.

The Bell car will be manufactured in two models, a roadster and a five-passenger touring car. The cars will be fully equipped. Ernest T. Gilliard, former chief engineer and designer for the Sphinx Motor Car Co., this city, will fill this capacity for the new company. The body design for the new car is now being worked out and the 1916 model will contain a number of distinctive features.

Application will be made to Governor Brumbaugh, Tuesday, June 8, for a charter for the intended corporation. The incorporators are Henry M. Stauffer, Lancaster; Dr. Harry W. Posey, Woodbine, York county; Dr. B. Frank Posey and Ernest T. Gilliard, York. The proposed new industry is to be a close corporation and the entire issue of stock is to be held by the four incorporators. At a recent meeting the following officers were elected: President, Henry M. Stauffer; vice-president, Dr. Harry W. Posey; secretary and treasurer, Dr. B. Frank Posey.

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Changes in Hupp Ranks

DETROIT, MICH., May 17—J. E. Fields, formerly connected with the advertising department of the Chalmers Co. has been appointed director of service for the Hupp Motor Car Co. Other Hupmobile appointments include Frederick Dickinson, assistant advertising manager; and O. C. Hutchinson, district manager, in charge of factory distribution warehouses in Boston and New York.

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McIntyre Files Petition

AUBURN, IND., May 15—W. H. McIntyre, this city, automobile manufacturer has filed a voluntary petition in bankruptcy before United States Commissioner Thomas J. Logan in Federal court. He schedules his liabilities at $183,440.49 and his assets at $5,015, $600 of which he claims exempt under the bankruptcy laws of the United States. In his petition he says that he is a manufacturer's manager by occupation, although the business with which he is identified is not mentioned. The indebtedness is mostly in notes, held by different banks. The Hamilton National, of Fort Wayne, holds notes of from $500 to $10,000 and the First National bank, of Fort Wayne, holds his notes from $478 to $10,000. Other notes are held by the City National bank, of Auburn; the Savings Loan & Trust Co., Auburn, and the Northern National bank, Toledo, O. In the lists of assets is mentioned real estate valued at $5,000 although there is a mortgage on his property amounting to $1,500, held by the Commercial bank at Ashley, Ind. The petition states that the notes are secured by mortgages on the McIntyre automobile plant.

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Asks Receiver for Motsinger

LA FAYETTE, IND., May 13—Thomas Sharp Wilson, who recently was removed as treasurer and director of the Motsinger Device Mfg. Co., yesterday filed a petition in the circuit court asking for a receiver for the company. The latter was incorporated several years ago to manufacture the Motsinger carbureter. Wilson's petition alleges that he has $10,000 worth of stock in the company, that the liabilities will amount to $30,000, and the building and equipment will not bring $40,000. The petition alleges that Motsinger is advertising the sale of $15,000 of new stock, in addition to the original $150,000 capital.

War Trucks Feature of Exports

United Kingdom Still Largest Buyer of American Vehicles —Passenger Cars Fall Off

WASHINGTON, D. C., May 14—Gross statistics of the exports of motor cars, in March, already published in THE AUTOMOBILE are supplemented this week by the bureau of foreign and domestic commerce by detailed figures. The interesting feature of the figures is the tremendous increase in the number of commercial cars shipped abroad in March last, as compared with the exports for the same month of last year. The figures show that during March last 1,339 motor trucks, valued at $4,725,563 were shipped abroad, and it is understood they went to the warring countries in Europe. In March a year ago the number shipped abroad was fifty and the value $63,932. During the 9 months ended March the exports of trucks increased from 543, valued at $861,654, in 1914, to 6,313, valued at $18,737,487, in 1915.

Passenger Cars Drop 1109

On the other hand the exports of passenger cars dropped from 3,538, valued at $2,984,915, in March, 1914, to 2,429, valued at $1,958,302, in March last, and from 19,928, valued at $17,904,002, during the 9 months of 1914 to 11,563, valued at $9,551,731, during the same period of 1915.

As has been the case for a number of years, the United Kingdom was the largest buyer of American cars during the periods under consideration. The exports of cars, both commercial and passenger, increased from 819, valued at $637,884, in March, 1914, to 1,566, valued at $2,468,014, in March last, while during the 9 months' period the number increased from 5,732, valued at $4,542,123, in 1914 to 6,197, valued at $8,915,029, in 1915.

While France imported only 164 cars, valued at $98,427, in March, 1914, the number in March, 1915 increased to 460, and the value to $1,918,053, while during the 9 months' period the number increased from 700, valued at $509,241, in 1914, to 2,896, valued at $8,325,140, in 1915.

The blockade on Germany is shown by the fact that in March, 1914, 361 cars, valued at $264,203, were shipped to that country, while in March last the number had decreased to four and the value to $2,800. During the 9 months' period the exports to Germany dropped from 951, valued at $677,347, in 1914, to 20, valued at $20,164 in 1915.

Italy's imports of American cars amounted to 23, valued at $13,664, in March, 1914, and during March last the number exported also was twenty-three, but the value had dropped to $13,273. During the 9 months' period the shipments to that country declined from 234, valued at $163,808, in 1914, to sixty-five, valued at $48,385, in 1915.

Under the head of "other Europe" the exports show a decline in number but an increase in value. In March, 1914, the shipments amounted to 590, valued at $498,142, while in March last shipments were 431 and the value $1,293,577. During the 9 months' period the number exported was 1,741, valued at $1,404,969, while during the 9 months of 1915 it was 1,263, and the value $3,594,223.

Effect of the War on Canada

The effect of the war is shown in the exports to Canada, the returns showing that during March, 1914, the number of cars shipped to that country was 500, valued at $531,029, while in March last the number had increased to 345 and the value to $317,516. During the 9 months' period the number decreased from 2,555, valued at $3,471,086, in 1914, to 2,072, valued at $2,553,942, in 1915.

Automobile Exports and Imports for March and Preceding 9 Months

	March				9 Months Ending March			
	1914		1915		1914		1915	
	Number	Value	Number	Value	Number	Value	Number	Value
EXPORTS								
Automobiles								
Commercial	50	$63,932	1,339	$4,725,563	543	$861,654	6,313	$18,737,487
Passenger	3,538	2,984,915	2,429	1,958,302	19,928	17,904,002	11,563	9,551,731
Total	3,588	$3,048,847	3,768	$6,683,865	20,471	$18,765,656	17,876	$28,289,218
Parts								
Parts	....	701,038	....	762,386	.....	4,923,339	.....	4,116,608
Total	....	$3,749,885	....	$7,446,251	.....	$23,688,995	.....	$32,405,826
BY COUNTRIES								
Automobiles								
France	164	$98,427	460	$1,918,053	700	$509,241	2,896	$8,325,140
Germany	361	264,203	4	2,800	951	677,347	20	20,164
Italy	23	13,664	23	13,273	234	163,808	65	48,385
United Kingdom	819	637,884	1,566	2,468,014	5,732	4,542,123	6,197	8,915,029
Other Europe	590	498,142	431	1,293,577	1,741	1,404,969	1,263	3,594,223
Canada	500	531,029	345	317,516	2,555	3,471,086	2,072	2,553,942
Mexico	21	24,139	9	4,861	154	241,667	58	59,635
West Indies and Bermuda	36	34,682	223	136,675	408	383,281	874	576,317
South America	129	114,276	205	96,599	1,592	1,614,860	808	434,051
British Oceana	561	491,850	284	252,212	3,077	2,658,621	2,164	1,788,803
Asia and other Oceana	196	186,647	132	115,366	1,664	1,617,970	946	1,559,043
Other countries	188	154,904	86	64,919	1,663	1,480,683	513	414,486
Total	3,588	$3,048,847	3,768	$6,683,865	20,471	$18,765,656	17,876	$28,289,218
Tires								
Belgium	....	.....	....	.....	.....	$15,429	.....	.....
France	....	.....	....	.....	.....	.....	.....	$6,090
Germany	....	$18,396	....	.....	.....	88,930	.....	.....
England	....	171,127	....	$449,560	.....	1,031,117	.....	1,530,701
Canada	...	74,927	....	50,000	.....	583,412	.....	464,392
Mexico	....	6,296	....	8,332	.....	100,249	.....	73,349
Philippine Islands	....	10,283	....	3,384	.....	110,803	.....	160,631
Other countries	....	46,075	....	116,229	.....	449,019	.....	652,445
Total	....	$327,104	....	$627,505	.....	$2,378,959	.....	$2,887,608
IMPORTS								
Automobiles .....dut.	15	$15,867	17	$28,105	245	$545,226	244	$405,021
Parts of (except tires)...dut.	....	90,928	....	73,302	.....	488,730	.....	640,215
Total automobiles and parts of	....	$106,795	...	$101.407	.....	$1,033,956	.....	$1,045,236
BY COUNTRIES								
Automobiles								
France	7	$7,008	2	$9,360	110	$264,600	40	$100,371
Germany	....	.....	....	.....	15	37,307	6	13,606
Italy	5	5,679	1	2,000	44	64,345	91	96,920
United Kingdom	1	1,500	3	5,676	37	111,722	60	143,032
Other countries	2	1,680	11	11,069	39	67,252	47	51,092
Total	15	$15,867	17	$28,105	245	$545,226	244	$405,021

Other countries show losses all along the line. Mexico's imports of American cars fell from 21, valued at $24,139, in March, 1914, to 9, valued at $4,861, in March last, while during the 9 months' period the number fell from 154, valued at $241,667, in 1914, to 58, valued at $59,635.

British Oceana imported 561 American cars, valued at $491,850, in March, 1914, while in March last the number decreased to 284 and the value to $252,212. During the 9 months' period the number decreased from 3,077, valued at $2,658,621, in 1914, to 2,164, valued at $1,788,803, in 1914.

In March, 1914, Asia and other Oceana 196 cars, valued at $185,647, were imported from this country, while in March last the number fell to 132 and the value to $115,366. During the 9 months' period the number decreased from 1,664, valued at $1,617,970, in 1914, to 946, valued at $1,559,043, in 1915.

One hundred and twenty-nine cars, valued at $114,276, were exported from this country to South America in March, 1914, while during March last the number increased to 205 and the value decreased to $96,599. The 9 months' period shows a loss from 1,592 cars, valued at $1,614,860, in 1914, to 808 cars, valued at $434,051, in 1915.

The full statistics are given in the accompanying table.

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Continental Motor Adds 90,000 Square Feet

DETROIT, MICH., May 17—Additions to the plant of the Continental Motor Mfg. Co., in Muskegon, Mich., have been started and when completed will provide 90,000 square feet of additional floorspace. This will make the total of the Muskegon plant 350,000 or equal to the space of the Detroit plant.

It means that the Continental company will have a total of 700,000 square feet of floorspace.

The additions will consist of a three-story building 60 by 200 feet, to be used for the screw products; a three-story shipping building; the erection of a new testing department or building and a new heating plant. The buildings alone will probably cost about $50,000, being made of reinforced concrete and steel, while the new machinery to be installed will be worth $150,000 to $200,000.

The company hopes to build 10,000 more four-cylinder motors when the increased production facilities are completed.

At the Detroit plant the additions which were started last year are now all finished.

It is estimated by the Continental company that by July first 50,000 motors for 1915 will have been delivered.

Concerning the 1916 output nothing definite is available but it is thought quite possible that under normal conditions the output will not be far from 65,000 motors.

There are now 3,800 men employed in the two plants. When the Muskegon plant is completed the total working force will be increased to about 4,900 men.

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$19,000 for Breach of Contract

CHICAGO, ILL., May 19—*Special Telegram*—Cecil E. Gibson and B. F. Meixell have been awarded $19,000 damages from the American Motor Car Sales Co. by the jury in the superior court of Marion county.

Suit was brought by the plaintiffs for $150,000 damages for alleged breach of contract. Gibson and Meixell claimed they were Marion agents in 1909 and 1910 in Indianapolis and that the agency was taken away from them without due cause, the loss in profits amounting to the sum asked for.

According to John N. Willys, then head of the Marion concern, there always was a dispute as to whether or not there was a contract. It was claimed by defendant that if there was a contract the plaintiffs would have been unable to sell any considerable number of cars and the defendant would have settled for a reasonable amount, possibly $25,000. The verdict of the jury is in keeping with defendant's contention as to the amount of damages.

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Now the Gemco Mfg. Co.

MILWAUKEE, WIS., May 17—The Garage Equipment Mfg. Co., of Milwaukee, Wis., originally incorporated as the Garage Equipment Co., has made a second change in its style and will henceforth be known as the Gemco Mfg. Co. The change is made to conform with the now well established trademark "Gemco."

—

Colby Motor Co. Assets To Be Sold May 26

MASON CITY, IA., May 14—The receiver's sale of the Colby Motor Co., of this city will be held here Wednesday, May 26. Samuel A. Schneider, receiver, has issued a small booklet showing the various parts to be disposed of. The sale will include five buildings comprising office and factory and much personal property intended for cars, such as 100 radiators, 100 frames and other items including steering gears, electric wiring, windshields, bolts and nuts, springs, body, etc. The buildings, including approximately 7 acres of land, will be sold first. The personal property will then be sold in smaller blocks, the sale continuing until all the property is sold.

Auction Lozier's Plattsburg Plant

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Sale Begins May 26—15 Brick Buildings, Machinery, Tools, Raw Stock, Etc.

PLATTSBURG, N. Y., May 14—The Lozier Motor Co. plant at Plattsburg, valued at $1,000,000, will be sold at public auction beginning May 25 by Charles Shongood, auctioneer, New York City.

The sale will include about $100,000 worth of tools and bids will be received for about 100,000 feet of single and double-ply belting in all sizes. The raw stock offered includes about 500 tons of new iron and steel, rods, tubing and sheets of soft and high-speed tool steel.

The Lozier marine department, consisting of the service, good will and everything pertaining to it, will be sold in one lot as a going business.

The real estate which will be sold comprises fifteen modern brick buildings, equipped with traveling cranes, electric motors, air compressor system and all equipment of an up-to-date plant. The property covers 145,000 feet of floor space and is situated on a 327-acre plot, having canal as well as railroad connections. The plant will be sold in parcels to suit buyers.

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Columbus Buggy Assets Sold—To Supply Parts

COLUMBUS, O., May 14—The auction sale at the plant of the New Columbus Buggy Co., held May 12 and 13, was a success in every particular. A large number of buyers were present not only from Ohio but also from adjoining states.

The first day was devoted to the sale of sixty-five automobiles, which were disposed of at good auction prices within 2 hours.

There were thirty-five new electrics, twelve new gasoline cars and the remainder were used cars. All of the materials on hand and equipment, with the exception of the patterns for the making of parts, were disposed of also. The company retained the patterns and will continue to furnish parts. This business will be under the management of L. M. Browne. The buggy business was sold to A. Webber, of Louisville, Ky., who will move it to that city.

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Gordon Rubber May Increase Capital

CANTON, O., May 15—The Gordon Rubber Co., Canton, O., through its directors, will meet June 10, to consider the increase of the capital stock from $300,000 to $600,000 to care for the erection of a shop and other extensions which will double the capacity of the plant.

10,000-Miles Solid Tire Warranty

British Manufacturers Adopt Standard Guarantee for 1 Year of Service

LONDON, ENG., May 3—British tire manufacturers have agreed upon a standard solid tire guarantee of 10,000 miles within a period of 1 year, as a result of investigations by the Solid Tire Committee. This guarantee has been adopted by over twenty firms, representing most of the important makers of tires in England. The guarantee is as follows:

"Solid rubber tires supplied for use in the United Kingdom are guaranteed for 10,000 miles' service. We undertake that on a claim being admitted by us, the tire will be repaired free, or replaced at a charge proportionate to the failed mileage or unexpired time at our option, and in cases where tires are so replaced, the failed tires become our property. This guarantee is given subject to the following conditions:

"1—Claims under the guarantee must be made within 12 months from the date of the sale of the tire by us.

"2—The vehicle to which the tire is fitted shall be maintained in good running order, shall not be run at excessive speed, the brakes shall not be applied so as to cause the tires to skid, and no error in wheel alignment shall be permitted.

"3—The total load shall not at any time exceed that set out in the schedule below for the respective sections of tires:

SCHEDULE OF LOADS

Section of Tire, mm.	Approximate Inch-Size	Maximum Load per Tire in Pounds
75	3	1,120
85	3½	1,496
90	3½	1,680
100	4	2,128
110	4½	2,576
120	4¾	3,024
130	5	3,476
140	5½	3,696

"4—No liability will be accepted by us for accidents to vehicles, property, or individuals arising in respect of vehicles fitted with tires, the subject of this guarantee, and this guarantee is given instead of and expressly excluding any kind of implied condition or warranty, and the damages for which we make ourselves responsible hereunder are limited to the replacement of failed tires as above mentioned.

"5—And such other conditions as may be set out in our terms of sale.

"Note: The guarantee in the above terms may be extended, at the option of the tire maker, to cover tires applied to countries outside the United Kingdom, provided that the mileage guaranteed shall not exceed 10,000 miles, and for a period of no more than 12 months."

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Mileage Test for Victor Tires

SPRINGFIELD, O., May 17—The Victor Tire & Rubber Co. has begun a mileage capacity test of its new pneumatic tires by fitting a set of Victor tires to a Cole eight and running the car a total of 300 miles daily for as many days as the tires hold out. The car is run 150 miles each day and 150 miles each night.

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Market Prices Steady

NEW YORK CITY, May 18—Market prices this week were steadier with few changes. Most of the changes were small. Most of the metals were strong. Aluminum went up 1-4 cent, being firm and in good demand. Lead, though unchanged, was stronger. Trade, however, in copper and tin has been kept within very narrow limits. Domestic consumers in copper display small interest and there is very little export demand temporarily. At the same time there is no pressure to sell, and prices for electrolytic continue nominal at 18 3-4 cents. Lake copper continued irregular, dropping to 18 1-2 cents on Friday. Tin went down $1.00 per 100 pounds. The restrictions against sales of tin in the local market are keeping trade down and forcing consumers to pay a premium of nearly 2 cents per pound over the importation cost.

Fine Up-river Para rubber went up 1 cent with offerings light. Manufacturers did not evince much interest and the transactions reported were restricted to comparatively small quantities. A light shipment of rubber was received last week from London and Liverpool.

Cyanide potash rose 1 cent last week, this being the only change that occurred in the oils, lubricants and chemical markets. Petroleum prices were generally steady. Linseed oil was in moderate demand and steady while rapeseed oil was quiet with prices unchanged.

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Fisk Adds Three Buildings—More in Prospect

CHICOPEE, MASS., May 15—The Fisk Rubber Co. has started construction on additional buildings for its factory. Plans have been drawn by G. B. Allen, of Hartford, for three structures on the property acquired by the company on Oak and Grove streets. The additions will give the company a two-story branch store and service station, a six-story reinforced concrete storehouse 110 by 310 feet, and a six-story office building 60 by 100 feet. At the present time there is under construction a seven-story addition to the Nos. 7 and 8 mills of the company. When the new buildings being contemplated are finished it will give the factory a floorspace of 22 acres instead of the 14 it has at present. The company does not propose to stop even when these new buildings are done if the conditions warrant it, for the plans allow for an increase to 60 acres of floorspace. Railroad spur tracks with a capacity of forty cars have been planned. There are now 3,000 men employed at the factory.

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Stevens-Duryea Plants Purchased by Westinghouse

SPRINGFIELD, MASS., May 13—Negotiations have been definitely completed for the purchase of the plant and business of the J. Stevens Arms & Tool Co., Chicopee Falls, and the plants of the Stevens-Duryea Co., in the same city and East Springfield.

The corporate and commercial identity of the J. Stevens Arms & Tool Co. will be retained, and its usual line of rifles will be manufactured. When the war order rush is over, the usual line of Westinghouse products will be manufactured at the plants. It is expected that employment will be furnished for 8,000 men by the new business.

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Five-Story Addition for New Process Gear Co. Plant

SYRACUSE, N. Y., May 15—The New Process Gear Co. is rushing plans of new five-story factory building to be 240 feet

Daily Market Reports for the Past Week

Material.	Tues.	Wed.	Thurs.	Fri.	Sat.	Mon.	Week's Changes
Aluminum	.19½	.19½	.19¼	.19½	.19½	.19¾	+.00¼
Antimony	.34	.34	.34	.34	.34	.34	.....
Beams & Channels, 100 lbs.	1.31	1.31	1.31	1.31	1.31	1.31	.....
Bessemer Steel, ton	19.00	19.00	19.00	19.00	19.00	19.00	.....
Copper, Elec., lb.	.18⅝	.18⅝	.18⅝	.18⅝	.18⅝	.18¾	+.00⅛
Copper, Lake, lb.	.19	.19	.19	.18½	.18½	.18½	—.00½
Cottonseed Oil, bbl.	6.39	6.30	6.30	6.24	6.25	6.29	—.10
Cyanide Potash, lb.	.23	.23	.23	.24	.24	.24	+.01
Fish Oil, Menhaden, Brown	.41	.41	.41	.41	.41	.41	.....
Gasoline, Auto, bbl.	.12	.12	.12	.12	.12	.12	.....
Lard Oil, prime	.90	.90	.90	.90	.90	.90	.....
Lead, 100 lbs.	4.20	4.20	4.20	4.20	4.20	4.20	.....
Linseed Oil	.67	.67	.67	.67	.67	.67	.....
Open-Hearth Steel, ton	19.00	19.00	19.00	19.00	19.00	19.00	.....
Petroleum, bbl., Kans., crude	.40	.40	.40	.40	.40	.40	.....
Petroleum, bbl., Pa., crude	1.35	1.35	1.35	1.35	1.35	1.35	.....
Rapeseed Oil, refined	.82	.82	.82	.82	.82	.82	.....
Rubber, Fine Up-River, Para	.60	.61	.61	.61	.61	.61	+.01
Silk, raw, Ital.	..	..	3.90	..	..	3.90	.....
Silk, raw, Japan	..	..	3.55	..	..	3.52½	—.02½
Sulphuric Acid, 60 Baume	.90	.90	.90	.90	.90	.90	.....
Tin, 100 lb.	40.00	39.50	39.50	39.25	39.00	39.00	—1.00
Tire Scrap	.05	.05	.05	.05	.05	.05	.....

long by 75 feet wide giving 90,000 additional square feet of floorspace. This is expected to be completed October 1. This is in addition to the new four-story building at present under construction.

For the first 4 months of 1915 the company's business has increased 50 per cent., and there is on order machinery totaling in value $150,000 for installation in the new buildings.

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Ford to Double Kansas City Plant

KANSAS CITY, MO., May 19—The Ford Motor Co. will double its assembling plant here. To the present three-story 77 by 420-foot plant there will be added a three-story building 400 by 120. The cost is estimated at $250,000.

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Ford Plant for Winnipeg

WINNIPEG, MAN., May 14—Work will be commenced immediately on the erection of an assembly plant here for the Ford Motor Co. The new factory will cost upward of $250,000, and the site is admirably situated, having track facility for shipping purposes, which will allow of the rapid movement of raw material and finished cars. The new plant will be four stories in height.

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Fickling Buys Dunlap Wheel Plant

LONG ISLAND CITY, May 14—The Fickling Enameling Corp., this city, has purchased the enameling plant of the Dunlap Wire Wheel Co., located in Long Island City. This plant is one of the best and most up-to-date plants for enameling wire wheels in the country. The corporation is prepared to continue the service supplied by the Dunlap company.

Further Declines in Securities

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Wild Rumors and President's Message to Germany Affect Market—Few Gains

NEW YORK CITY, May 15—Wild rumors again had their deadly effect on security prices this week. A violent collapse occurred when word was passed around that President Wilson had been assassinated. During the decline certain interests responsible for the rumor took advantage and cleaned up a tidy sum of money. The stock exchange authorities have ordered an investigation, having thus far traced the report to Pittsburgh.

After the facts of this rumor were known the market picked up, prices seeming to gather strength as time went on until finally the entire market developed a substantial rally, until Friday morning, when President Wilson's note to Germany was made public. The market seemed to interpret it most seriously and prices immediately began to melt away and steadily dropped to the lowest recent figures.

The predictions that Germany would return a favorable reply influenced extensive short covering, which appeared to be the chief source of the buying on Saturday.

A few tire and motor issues closed with gains. Firestone common rose 5 points while that of Kelly-Springfield rose 15 points, the largest gain for the week. International Motor common rose 2 1-2 points and its preferred rose 6 points. Packard preferred rose 4 1-2 points. Chalmers preferred rose 1 point. The drops ranged from 1 to 19 points.

Detroit securities were a little stronger last week, the gains ranging from 1 to 5 1-4 points. Packard common rose 5 1-4 points and its preferred rose 1 point; Continental common rose 5 points while the preferred rose 1 1-2; Chalmers preferred rose 2 points.

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Disposes of Lyons-Atlas Interests

INDIANAPOLIS, IND., May 15—J. W. Lyons, who was succeeded by E. H. Pampell in the presidency of the Lyons-Atlas Co., has disposed of his interest in that concern. Mr. Pampell is a Rock Island man.

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Pope Co. Not Insolvent

HARTFORD, CONN., May 15—Creditors of the Pope Mfg. Co. can take a grain of hope from the statements of Arthur L. Shipman, associate counsel for Receiver George Pope, made in superior court Friday. To a direct question asked by Judge Burpee, Mr. Shipman said that the concern is not insolvent. Up to the present time the receiver has paid 45 per cent. on claims to creditors.

Charles A. Persons, one of the receivers of the company in Massachusetts, said: "The company's business and condition in this state is, we think, in a very healthy state.

"February shipments were $72,272; March, $135,024; and April, $148,464. As receivers we started with no cash, and now have $177,000 on hand. On April 30 our bills payable amounted to $31,512, while our receivables, after reserve and suspense, were $384,740."

Automobile Securities Quotations on New York and Detroit Exchanges

	1914 Bid	1914 Asked	1915 Bid	1915 Asked	Wk's Ch'ges
Ajax-Grieb Rubber Co., com	215	..	300	..	..
Ajax Rubber Co., pfd	99	..	101	..	..
Aluminum Castings pfd	98	100	98	101	..
J. I Case, pfd	81	83	80	88	—1
Chalmers Motor Company, com	92	95	91	94	—2
Chalmers Motor Company, pfd	90⅜	92½	95	98	+1
Electric Storage Battery Co.	..	..	49½	51	—1½
Firestone Tire & Rubber Co., com	287	292	490	..	+5
Firestone Tire & Rubber Co. pfd	106	109	110	112½	..
General Motors Company, com	83½	84½	128	129	—10
General Motors Company, pfd	92	93½	97	98	..
B. F. Goodrich Company, com	26¼	27	40	42	—3
B. F. Goodrich Company, pfd	89⅞	90	101	102	— ½
Goodyear Tire & Rubber Co., com	172	176	244	248	—1
Goodyear Tire & Rubber Co., pfd	98	100	105	106½	..
Gray & Davis, Inc., pfd	95	102½	..	..	..
International Motor Co., com	..	5	12½	13½	+2½
International Motor Co., pfd	3	10	31	32	+6
Kelly-Springfield Tire Co., com	..	..	131	134	+15
Kelly-Springfield Tire Co., 1st pfd.	..	..	83	86	..
Kelly-Springfield Tire Co., 2nd pfd.	..	..	130	140	..
Maxwell Motor Company, com	..	..	36	38	—10½
Maxwell Motor Company, 1st pfd	..	..	78½	80	—2½
Maxwell Motor Company, 2nd pfd	..	..	30	32	—8
Miller Rubber Company, com	..	..	180	188	..
Miller Rubber Company, pfd	..	..	104	105	..
New Departure Mfg. Co., com	123	125	106	..	..
New Departure Mfg. Co., pfd	105½	..	136	141	..
Packard Motor Car Co., com	103	..	103	..	—2
Packard Motor Car Co., pfd	94	98	99½	..	+4½
Peerless Motor Car Co., com	18	25	20	21	..
Peerless Motor Car Co., pfd	..	70	..	55	..
Portage Rubber Co., com	..	30	35	38	..
Portage Rubber Co., pfd	..	85	85	88	..
*Reo Motor Truck Company	8¾	9½	14½	15½	..
*Reo Motor Car Company	28	30	31	33	..
Splitdorf Electric Co., pfd	40	50	..	..	..
Stewart-Warner Speed. Corp., com	48	50	60	63	—8
Stewart-Warner Speed. Corp., pfd	99	100	102	104	—1

	1914 Bid	1914 Asked	1915 Bid	1915 Asked	Net Ch'ges
Studebaker Corporation, com	34	35	61	63	—5
Studebaker Corporation, pfd	90½	91½	97	99	—4
Swinehart Tire & Rubber Co.	60	65	80	90	..
Texas Company	140	141	121	123	—8
U. S. Rubber Co., com	58¾	59	60	61	..
U. S. Rubber Co., pfd	102⅝	102⅞	104	106	—2
Vacuum Oil Company	115	119	194	197	—19
White Company, pfd	107	110	103	108	..
Willys-Overland Co., com	48	52	109	111	—8
Willys-Overland Co., pfd	88	92	98	100	—2
OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE					
ACTIVE STOCKS					
Chalmers Motor Co., com	92	..	..	92	—3
Chalmers Motor Co., pfd	90½	93	95	98	+2
Continental Motor Co., com	150	180	175	185	+5
Continental Motor Co., pfd	..	80	83½	85½	+1½
General Motors Co., com	83½	84½	128	130	—11
General Motors Co., pfd	92	93½	98	100	..
Maxwell Motor Co., com	10½	11⅛	35	39	—10
Maxwell Motor Co., 1st pfd	42½	43½	76½	78	—4
Maxwell Motor Co., 2nd pfd	17	18	31	32½	— ¼
Packard Motor Car Co., com	103	..	103	105	+5¼
Packard Motor Car Co., pfd	97½	..	98	100½	+1
*Reo Motor Car Co	..	28¾	32½	33½	+1¾
*Reo Motor Truck Co	9¾	10½	14¾	15½	— ¼
Studebaker Corp., com	..	..	61½	63½	—5¾
Studebaker Corp., pfd	..	..	..	100	—2
INACTIVE STOCKS					
*Atlas Drop Forge Co	..	21	..	26	..
Ford Motor Co. of Canada	..	555	700	..	..
Kelsey Wheel Co.	..	193	195	..	..
*W. K. Prudden Co.	..	21	19½	21	..
Regal Motor Car Co., pfd	..	35	..	25	..
BONDS					
General Motors, notes 6's, 1915	101	102	..	..	..
Packard Motor Co. 5's, 1916	95	98½	98¼	..	..

*Par value $10, all others $100 par value.

Maxwell Wins at Columbus

Endicott Covers 100 Miles in 1:38:28 2-5—Rickenbacher Stars First Day

COLUMBUS, O., May 17.—One of the most successful race meetings ever held in Columbus took place at the Columbus Driving Park May 15 and 16. The weather was favorable, and the crowd on Sunday was the largest that ever attended an automobile race in the Buckeye capital. It is announced that about 18,000 attended.

The feature of the meeting was the 100-mile race, in which eleven cars started. This race was won by Endicott in a Maxwell in 1 hour 38 minutes and 28 2-5 seconds. He finished only 10 seconds ahead of Hearne in a Case, who had closely pursued him from the eightieth mile. Endicott did not stop at all during the race, and negotiated the last 25 miles with a bad front outside tire and the last 15 miles with two tires about ready to collapse. For the last 15 miles it was a question if the tires would hold out, as those on the Case driven by Hearne were good. Hearne stopped only once, in the seventy-seventh lap to adjust his clutch, and in so doing lost the lead which he had maintained from the seventeenth lap.

Two accidents occurred during the race, but luckily none were serious. Rickenbacher, driving a Maxwell, took the lead from the start and was almost a lap ahead on the seventeenth mile when his right front tire blew out and he went through the fence. He, as well as his mechanician, escaped injury.

Gotof, driving a National, went through the fence about the same place on the twenty-ninth lap and also escaped injury. Disbrow, driving a Case, went out on the forty-fourth lap because of a broken valve. Milton, driving a Mercer, had considerable trouble with his transmission, and Tidmarsh, with the Great Western, also had trouble. At the finish eight cars were still in the running, though all but five were really out of the race.

Louis Disbrow, while driving his Simplex Zip in an exhibition mile, went through the fence after breaking his right front axle, but like the other two escaped injury. He was driving alone.

Rickenbacher Wins 25-Mile

During the first day's racing the feature was the 25-mile minor sweepstakes and consolation race. There were eight starters in this event, which was won by Rickenbacher in a Maxwell in 23 minutes and 18 3-5 seconds. Hearne, in a Case, was second, and Raimey, in a Case, was third.

Some interest was stirred up in the match race between Disbrow in his "Jay Eye See" and Rickenbacher in his "Blitzen Benz." This was scheduled for the first day, but Rickenbacher entered under protest because of a broken magneto. He tried to have the magneto repaired and started the second day, but was bested by Disbrow in 1:04 2-5. Rickenbacher's car did not run well.

In the 5-mile free-for-all final heat Raimey, in a Case, won, with Hearne, in a Case, second and Disbrow, in a Simplex Zip, third. The time was 4:58 3-5.

In the Australian pursuit race Endicott won on the seventh lap by passing Brown in a Chalmers, Jennings in a Keeton and Tidmarsh's Great Western.

In the exhibition performances Disbrow in his "Jay Eye See" covered a mile in 52 4-5, while Rickenbacher went the distance in the "Blitzen Benz" in 51 3-5.

In the team match race between the Maxwell and the Case teams, Hearne in a Case covered the 5 miles in 4:55 2-5, with Raimey in a Case second in 4:55 4-5 and Endicott in a Maxwell third in 4:56.

There were six starters in the 5-mile consolation race, which was won by Tidmarsh in the Great Western in 5:11 3-5. Clarke in a Tornado was second and Gotof's National third.

Chicago Automobile Club To Handle Speedway Race

CHICAGO, ILL., May 14.—By a contract signed today by President J. T. Brown of the Chicago Automobile Club and David F. Reid, president of the Speedway Park Assn., the C. A. C. is given complete control of the first 500-mile race to be held on Chicago's new speedway June 19. The contract provides that the club shall have "absolute and exclusive control of the track, pits, judges' stand and appurtenances thereto and all parties working thereon or therein on the 19th day of June and in the preliminary practice for the race." The local club is to receive for this service $1,000.

Guarantee of the purse of $54,000, the largest ever offered for a motoring event, is provided by the stipulation that it be placed in the hands of the referee 4 days prior to the race. The contract also calls for the completion of the track by June 5. According to the contractor, the surface will be ready for practice by June 1.

Arrangements with the speedway are similar to those under which the C. A. C. conducts the annual Elgin road races. The club is to provide all officials.

Work Starts on Twin City Speedway—Race in October

MINNEAPOLIS, MINN., May 15—Work was begun on the Speedway of the Twin City Motor Speedway Co., Fort Snelling. The first sod was turned by Mayor Winn Powers, of St. Paul. Representatives were present from the Minneapolis Civic & Commerce Assn. and the St. Paul Association of Commerce. The contractors will move 200,000 cubic yards of dirt at a cost of about $30,000. Two million feet of dimension timber has been ordered and 50,000 barrels of concrete. The track is to be completed by August 15. The first race is planned for the first Saturday in October. A Twin-City 500-mile classic will be run annually, and another race for July 4, 1916, and thereafter each year.

$12,000 for Hamline Races

MINNEAPOLIS, MINN., May 15—For the 2-day automobile races at the State Fair grounds at Hamline between Minneapolis and St. Paul next fall, a purse of $12,000 has been voted by the directors. The races will be September 8 and 11. Supervisor Charles Patterson and Superintendent J. R. Hickey will attend the Indianapolis race to interest drivers. The program will be made for a 150 or 200-mile race. The track is a 1-mile dirt oval. It has been rented to J. A. Sloan and E. A. Moross for a race June 26. The race is to be under auspices of the International Contest Assn.

Rules for Yellowstone Tours?

WASHINGTON, D. C., May 18—The possibility of horses taking fright at the sight of automobiles in Yellowstone Park when it is opened to motor traffic on August 1, has brought out a plan, worked out by Colonel Brett, U. S. A., the superintendent of the park, which will give entrance to the park during certain hours to automobiles alone, and during certain hours to horse-drawn vehicles alone. All traffic must be in one direction—opposite to the hands of the clock.

Table of Results in Columbus 100-Mile Race

Car.	Driver.	10	20	30	40	50	60	70	80	90	100	Time
Maxwell	Endicott	4	3	3	3	3	2	2	1	1	1	1:38:28⅖
Case	Hearne	2	1	1	1	1	1	1	2	2	2	1:38:38⅖
Edwards Special	Kennedy	7	7	6	6	6	5	3	3	3	3	
Tornado	Clarke	5	4	4	4	4	4	4	4	4	4	
Case	Raimey	6	6	5	5	5	5	5	5	5	5	
Chalmers	Brown	9	9	8	8	8	6	6	6	6	6	
Great Western	Tidmarsh	8	8	7	7	7	7	7	7	7	7	
Case	Disbrow	3	2	2	2	2	out, broken valve.					
Mercer	Milton	11	10	out, dropped driveshaft.								
National	Gotof	10	5	out, went through fence.								
Maxwell	Rickenbacher	1	out, went through fence.									

New Jitney Assn. Is International

Headquarters at Kansas City—Insurance Plan Approved—Officers Elected

KANSAS CITY, MO., May 14—Fixing permanent headquarters at this city and electing as its officers men who live in this vicinity, the first International Jitney Assn. convention was brought to a close by a resolution thanking the American Federation of Labor for indispensable assistance. The place of the next annual convention is to be submitted to a majority referendum on February 1.

The convention recognized three breakers ahead—legislation and danger of the disintegration of the association and the operating costs of jitney buses which is a very indeterminate factor.

A temporary committee on legislation reported that it was opposed to any drastic regulation at this time and proposed a wait until regulation could be intelligent. This was approved.

There was enthusiasm and comradeship among the members, several of whom represented several associations. The backing of trade unionism has given the association most of its confidence and the closing resolution required that all purchases by the association should bear the union label, wherever possible. It was voted to make the organization international in order to admit Canadian operators.

To Study Operating Costs

Operating costs are to be studied by the committee on equipment and good roads and bulletins sent to the members. The convention hopes to get rates on supplies by giving its endorsement to certain commodities. Applications for associate memberships have been made by the Highland Body Co., Cincinnati, O.; Gramm Motor Truck Co., Lima, O., and the Pennsylvania Rubber Co., Jeannette, Pa.

W. H. Miller, chairman of a temporary committee on insurance, reported that several different plans of insurance had been studied, and recommended, without prejudice to the others, the National Indemnity Exchange which will ask the state of Missouri for a charter when the new insurance laws go into effect on June 18.

The indemnity exchange has a mutual or lodge plan and will issue separate policies for fire and theft, public and passenger liability, property damage and collision insurance. It is said that the cost, which will be figured on a horsepower rate, will be from 50 to 75 per cent. less than that charged by old line companies.

A National Organizer

Local jitney associations are to be admitted to membership on payment of $10 fee and 25 cents initial membership fee for each car in each local association and 10 cents per month per car. Single memberships are $2 down and $1 per year.

As soon as money comes into the treasury, a national organizer is to be en-

Entries Vary Greatly in Displacement

(*Continued from page* 887)

there are two individual systems used, one with a plunger pump and the other with a rotary gear pump. There are also two independent ignition systems with two separate Bosch magnetos and two sets of sparkplugs. All the bearings except the connecting-rods and wristpins are ball design. The carbureter is a Zenith, and the tires 32 by 4 front and 33 by 4.5 rear of Nassau make on Rudge-Whitworth wire wheels. The gear ratio is 2.25 to 1 and the car weight is stated to be 1,750 pounds.

First Non-Stock Stutz Cars

Most of the details of the Stutz cars will be kept a secret until after the race. The cars are, however, different from any Stutzes as yet made and are interesting because they are the first pure racing machines as yet made by the Stutz company. All three will be alike. They have four-cylinder block motors 3 13-16 by 6.5 inches, giving just a little over 296 inches piston displacement. The wheelbases are 103 inches and they will be equipped with Silvertown cord tires on Houk wheels.

The motors have sixteen valves, four to a cylinder. The camshaft is overhead and the valves are set at an angle in the cylinder. The crankshaft is carried on three ball bearings and the motor is oiled by a combination force feed system which delivers oil independently to the ball bearings of the crankshaft and through the hollow shaft itself to the lower connecting rod bearings. The pistons are a special alloy and are very light, giving a motor designed for high speeds. The best efficiency is somewhere in the neighborhood of 2,800 r.p.m.

The gearset provides three speeds and the car weight is 2,150 pounds with oil in the motor but the tanks not full. The rear system is a duplicate of that employed on the regular stock Stutz model. It is stated that this new Stutz has already made faster time than the fastest time made by a Stutz car in the race of last year.

Cornelian Smallest Entry

The smallest entry in the race is the Cornelian. This car has a piston displacement of only 117 cubic inches, a little over 1-3 of the limit. The motor is a four-cylinder Sterling, valve-in-head design, 2.875 by 4 inches with 1.25-inch valve. The pistons are of aluminum alloy and the motor is said to be capable of a speed of 3,500 r.p.m. A flexible rear axle with four universals is one feature, two transverse half elliptic springs for the front suspension is another, and a third is the use of a single steel shell to form the body and frame. The car will be piloted by Louis Chevrolet.

Mercedes Overhauled

Ralph De Palma's Mercedes has been overhauled completely and fitted with a new body at the Packard factory. It also has a Packard carbureter. No change in the engine was necessary to bring it to the 300 cubic inch limit, as it always has had a displacement of 274 cubic inches, its dimensions being 3 5-8 by 6 inches. The horsepower is about 100, and the car weighs 2,300 pounds fitted with its new body and ready for the race. The body is streamline in type, and the wheelbase is 110 inches.

John De Palma's Delage is the machine which Rene Thomas drove at Indianapolis last year—the winner. Only, in order to bring it within the 300-inch limit, the National company is overhauling it and putting in smaller cylinders. In other respects it is without change.

The Emden is one of the dark horses as regards performance, although the specifications covering the main points have been announced. The car is entered by its builders, the Donaldson Bros., and is to be driven by Harry Grant Donaldson, with one of his brothers as mechanician. It is a four-cylinder design with 4.25 by 5.25 cylinders, having a piston displacement of 298 inches. 34 by 4 1-2 Silvertown cord tires are used on Rudge-Whitworth wire wheels. Ignition is by a Bosch double-distributor magneto and the carbureter is a Rayfield. It is geared 2 13-20 to 1.

Many of the entrants are keeping their specifications profoundly secret. The Sebring car to be driven by Joe Cooper is another of the cars of which little or nothing is generally known and the Bergdolls are likewise enveloped in secrecy.

gaged by the directors and sent on a tour. Where his time is engaged by an embryo local association, it is to reimburse the national body.

Several interesting statements were made in addresses to the convention. W. H. Miller, president of the Kansas City Transportation Co., said:

"It would take 4,800 Fords or 1,200 large buses to care for the overflow from our jitneys in this city alone today." He went on:

"I would insist that all operators be required to take a physical and mental examination in order that we have only fit drivers."

Harry G. Kyle, ex-police judge and attorney for the Kansas City Automobile Dealers' Assn. said: "For the permanency of your service I would recommend that you drive all the time, day and night, rain and shine. I notice that it is hard to get a jitney when the weather is bad. This will not maintain your popularity.

Factories to Meet Demand

"In my discussions with automobile dealers I find that many factories are planning extensively on a big jitney development.

"It is my honest opinion, after a study of the jitney situation, that there will not be a steel rail in any of our large cities in 10 years and that all local transportation will be by motor."

Officers of the Association

Officers of the International association are: Perry T. Allen, Springfield, Mo., attorney for the Teamsters and Chauffeurs' Union, president; E. F. Maxwell, manager of the Topeka Jitney Co., Topeka, Kansas, vice-president; E. K. Carnes, traffic manager of the Kansas City Jitney Assn., secretary-treasurer; Ross B. Gilully, Kansas City, Mo., general counsel; Dr. Gordon A. Beedle, Kansas City, Mo., national medical adviser.

The board of directors is to consist of president and vice-president and the chairman of three standing committees, as follows:

Ways and Means, William Haensler, secretary of the Auto Service Assn., San Antonio, Tex.; Insurance, Rex Means, St. Joseph, Mo.; Equipment and Good Roads, C. F. Morphu, manager of the Kansas City Transportation Co., Kansas City, Mo.

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Atlanta to New York City by Jitney

ATLANTA, GA., May 13—Atlanta to New York City by jitney is a new project about to be started by local promoters. This line will reach New York City by way of Washington. The name jitney will be used, although the fares charged will be the same as those now in vogue by the steam or trolley lines running parallel to the jitney route.

The promoters intend to make Atlanta the hub of a number of overland jitney lines, extending northwest to link up with the metropolis of the Southeast, such cities as Richmond, Washington, Baltimore, Philadelphia and New York.

The first lines will be from Atlanta to Aiken, S. C., on the northeast, Montgomery, on the southwest, and Chattanooga on the northwest, these to be initial links in the jitney lines to New York and New Orleans. The plan is to form an association, each member operating his cars over a specified number of miles, constituting one link in the route. Each scheduled car's run will be about 25 miles.

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Jitneys To Be Regulated in Texas

AUSTIN, TEX, May 14—Jitneys received a severe blow on May 5 when the constitutionality of the city ordinance of Fort Worth which sought to regulate the operation of jitneys, was upheld by the court of criminal appeals. This opinion affects the operators of jitneys all over the state.

The court today, in an opinion by presiding Judge Prendergast, held cities have a perfect right to regulate the operation of jitneys and motor buses. The contention of the applicant, I. W. Sullivan, who was convicted in the corporation court of the violation of the city ordinance of Fort Worth regulating jitneys, was that the $10 fee charged jitneys under the ordinance was occupation tax and therefore unconstitutional. The court held it was a license fee. The court also held that a city has the right to prescribe and designate the routes over which jitneys shall be operated as provided in the Fort Worth ordinance.

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Jitneys Boom in Kansas City

KANSAS CITY, MO., May 17—Jitney bus service in Kansas City is expanding as rapidly as did the touring car service at the beginning of the jitney era. The Kansas City Jitney Transportation Co. is adding to its number of cars on its routes, and increasing the schedules. The Kansas City Motor Bus Transportation Co. has been organized by ten individual owners of buses, and has installed a service to be 4-minute at rush hours, 6 minutes at other times, between the downtown district and a terminus near Electric Park, the amusement park of the city. The travel will be almost entirely over boulevards.

A regular motor bus service is in operation between Kansas City and Belton, Mo., 29 miles. A bus line operates, three round trips daily, between Parkville, 11 miles, and Kansas City. Another bus has just been put on a rural route; it operates between Independence, Mo., and Wellington, Mo., 35 miles, and is especially useful for produce delivery as well as passenger traffic.

Rural motor bus service from the city received a demonstration May 15, when several thousand visitors to Longview, the show farm of R. A. Long, millionaire lumberman, used that means of transportation in preference to the railroad.

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Jitneys Face Arrest

SEATTLE, WASH., May 10—Five hundred and fifty operators of taxicabs and jitney buses in Seattle are in danger of arrest for running automobiles for hire without complying with the new state law requiring such vehicles to be covered with bonds in the sum of $2,500 as protection for passengers in the event of injury. Prosecutions of jitney bus operators is to be begun at once by Prosecuting Attorney Alfred H. Lundin, following the conviction of the Seattle Taxicab Co. in the Superior Court of King County for having carried passengers without first having obtained a bond, as prescribed in the newly enacted statute.

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May Require Franchise

SAN DIEGO, CAL., May 11—Assemblyman Conrad of this city engineered a bill through the Senate at Sacramento without opposition, permitting cities by ordinance to require franchises for operation of jitney buses, sight-seeing motor trucks and taxicabs.

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Akron Trolley Revenues Affected

AKRON, O., May 14—Jitney competition will probably force the Northern Ohio Traction & Light Co., in Akron, to curtail its service. While the company had expected a good gain in street railway earnings owing to the increased industrial activity in Akron, the receipts of the street railway lines in that city for April, were $7,000 below those for April, 1914, and substantially all of this decrease was caused by the competition of the jitneys.

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$5 to $10,000 Bonds in Savannah

SAVANNAH, GA., May 14—With one important change the ordinance regulating jitney buses has been passed by City Council. Instead of graduating the bond according to a machine's carrying capacity, the ordinance was amended so as to require a $5,000 bond for one car and $10,000 bond for more than one car operated by a person or concern. The ordinance, as originally drawn, provided a bond for $1,000 for each passenger capacity of a car, with a maximum bond of $10,000.

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Jitney Package Delivery

ST. LOUIS, MO., May 3—Five-cent package delivery has been inaugurated here by some of the jitney bus people. Packages are delivered within restricted zones for 5 cents. Packages are naturally restricted as to size and weight, extra charge being made for excess.

Factory Miscellany

Troy Body's 3-Story Addition—The Troy Manufacturing Co., Troy, O., manufacturer of automobile bodies, is erecting a three-story addition to its plant.

Franklin's 3-Story Addition—The H. H. Franklin Mfg. Co., Syracuse, N. Y., is about to take bids on a three-story, 56 by 80-foot addition to its automobile factory.

Plughoff Visits Overland Plant—A. D. Plughoff, vice-president of the J. W. Leavitt Co., San Francisco, Cal., and directing Willys-Overland sales on the Pacific Coast, spent several days last week at the Toledo factory.

Rubber Plant Goes to Barberton—The Chamber of Commerce of Barberton, O., has completed negotiations for the removal of the plant of the People's Rubber Co. from Akron to Barberton. The old plant of the Summit Rubber Co. will be occupied and about 100 men will be employed.

J-M Subsidiary's Plant Burned—Several units in the Lockport, N. Y., plant of the Fibre Corporation Co. were burned on May 13 with a loss of $300,000. The fire started when lightning struck one of the buildings during a thunderstorm. The company is a subsidiary of the H. W. Johns-Manville Co.

Truck Part Order to Be Repeated—The Gramm-Bernstein Co., Lima, O., has received orders to duplicate at once a large order for truck parts which was being shipped to England on the Lusitania. The parts were to complete equipment of trucks which had been shipped previously. The plant started on the order at once.

Republic Rubber to Double Shift—The Republic Rubber Co., Youngstown, O., states that May will be one of the biggest months in the plant's history. Some departments are on double shift. The truck tire department is working overtime on a big foreign order. The automobile tire department will turn out 50 per cent. more tires this month than in May, 1914.

Victor Rubber to Add—The Victor Rubber Co., Springfield, O., will erect another building, to be two stories, 30 by 108 feet. It will be erected on the ground between the two wings of the main factory building. The addition will be much like the one which was completed a few weeks ago. Work is to be started at once.

Alco Plant Used to Mfr. Shrapnel—The big plant in Providence, R. I., where Alco cars and trucks were built and which has been idle since the American Locomotive Co. discontinued its motor construction, is to be reopened for the making of brass fuse heads for shrapnel for the Allies. Installation of new machinery has begun and it will give employment to about 1,000 men.

Tire Plant Moved to Mt. Vernon—The plant of the Motor Tire Re-Construction Co. has been moved from the outskirts of Long Island City to Mt. Vernon, N. Y., where the company will use two buildings, one being 100 by 60 feet, two stories high, and the other 130 by 70, four stories high. The New York City offices of the company have been moved to 52 Vanderbilt avenue, in the Vanderbilt Concourse Bldg.

To Rebuild Detroit Auto Dash Plant—Within about 48 hours the people of Milford, Mich., subscribed $1,476.50 towards a cash fund of $1,500, which is part of the conditions under which the plant of the Detroit Auto Dash Co. will be rebuilt. Experts stated that to replace the bare factory building it would require $4,564. It was decided that during 5 years the village taxes would be omitted. The new plant is to be ready within 4 or 5 weeks.

Canadian Ford Breaks Record—Two days after it announced to its men that a minimum wage of $4 a day was in effect, the Ford Motor Co. of Canada, Ltd., Ford, Ont., turned out a record production of cars. One hundred and seventy-one Ford cars were built and shipped on April 23. The best previous record was made on April 13, when 166 cars were shipped by the Ford company. The 1,700 employees of the company were working a 9-hour day up till April 21, when the wage increase was announced and when the hours of labor were shortened to an 8-hour day.

The Automobile Calendar

May 25-26.....New York City, National Assn. of Manufacturers' Convention; Waldorf Astoria.
May 27.....Chicago, Ill., Sociability Run of Chicago Motor Club to South Bend, Ind., H. H. Robinson.
May 29.....Indianapolis, Ind., 500-Mile Race, Indianapolis Motor Speedway.
May 29.....Philadelphia, Pa., Stone Harbor Memorial Day Run from Philadelphia.
May 29-30.....Seattle, Wash., Track Races; Northwest Automobile Assn.
May 31.....Newark, N. J., Track Race, Olympic Park, Matty Matthews Auto. Racing Assn.
May 31.....York, Pa., Track Race, York Fair Grounds, York Motor Club.
June 3.....New York City, 11th Annual Automobile Outing for Orphans; Orphans' Auto. Day Assn. of N. Y.
June 7-11.....San Francisco, Cal., National Electric Light Assn.
June 9.....Galesburg, Ill., 100-Mile Race, Galesburg District Fair Assn.
June 11-12.....Effingham, Ill., Hillclimb and Fuel Economy Test. Salt Creek Hill, Effingham Automobile Club.
June 12.....Brighton Beach, Track Race; E. A. Moross.
June 14-17.....Detroit, Mich., Summer Meeting of the Society of Automobile Engineers and Start of Cruise to Georgian Bay.
June 19.....Chicago, Ill., 500-Mile Race, Chicago Speedway.
July 3.....Sioux City, Ia., 300-Mile Race, Sioux City Speedway Assn.
July 4.....Visalia, Cal., Road Race; Tulare County Automomobile Assn.
July 4-5.....Tacoma, Wash., Road Race, Tacoma Speedway Assn.
July 5.....Omaha, Neb., Speedway Races, Omaha Motor Speedway.
July 5.....Visalia, Cal., Road Race, Tulare Co. Auto. Assn.
Aug.....Milwaukee, Wis., Independent Petroleum Marketers' Assn. of the U. S.; 1915 Convention in Milwaukee.
Aug. 2-3.....San Francisco, Cal., Tri-State Good Roads Assn., Third Annual Convention.
Aug. 20-21.....Elgin, Ill., Road Races.
Sept.....Indianapolis, Ind., Fall Show, Indiana State Fair.
Sept.....Peoria, Ill., Second Northwestern Road Congress.
Sept. 6.....Providence, R. I., Speedway Race; F. E. Perkins.
Sept. 6.....Detroit, Mich., Speedway Race; Detroit Speedway Club.
Sept. 8-11.....Hamline, Minn., 2-Day Meet at State Fair Grounds between Minneapolis and St. Paul, State Fair.
Sept. 13.....Oakland, Cal., Pan American Road Congress.
Sept. 17-18.....Peoria, Ill., Illinois Garage Owners' Assn. Convention.
Sept. 20-25.....San Francisco, Cal., International Engineering Congress.
Oct.....St. Louis, Mo., Show, Forest Park Highlands, St. Louis Automobile Manufacturers and Dealers' Assn.
Oct. 1-2.....Trenton, N. J., Track Races; Inter-State Fair.
Oct. 2.....New York City, Sheepshead Bay Motor Speedway Track Meet.
Oct. 6-16.....New York City, Ninth Electrical Exposition and Motor Show at Grand Central Palace.
Dec. 31.....New York City, Show; Grand Central Palace.
Jan. 22, 1916.....Chicago, Ill., Show; Coliseum.

The Week in the Industry

Gockenbach Columbus Fisk Mgr.—The Fisk Rubber Co. has opened a branch in Columbus, O., located at 206 East Gay street in charge of H. S. Gockenbach as manager.

Sommerville Rolls Royce Rep. at Exposition—A. G. Sommerville has been named special representative at the Panama Pacific International Exposition for the Rolls Royce, Ltd., of London.

Kidder Toledo Goodrich Mgr.—H. W. L. Kidder has been appointed manager of the B. F. Goodrich Co. branch in Toledo, O., succeeding C. W. Wacker, who has been promoted to the Cleveland territory.

Hipple N. Y. Mitchell Sales Mgr.—George Hipple, sales manager of the A. Elliott Ranney Co., New York City, former distributor for the Hudson car, has resigned to go with the Carl H. Page Motors Co., the new Mitchell agency, in the capacity of general sales manager.

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Garage

North Platte Garage Destroyed—The Hinman garage at North Platte, Neb., was destroyed by fire recently, twenty automobiles in it also being burned; loss, $20,000 to $30,000.

St. Louis Fisk in New Home—The Fisk Rubber Co. has become installed in its new home in St. Louis, Mo., with an entirely new equipment of tire and vulcanizing machinery.

New California Firestone Branch—The Christensen Auto Supply Co., Long Beach, Cal., is the name of a new firm which is handling the Firestone products. P. C. Christensen heads the firm.

Noncarbine Opens In Boston—L. W. Abbott, New England representative of Noncarbine, has just opened salesrooms in Boston, Mass., at 157 Massachusetts avenue, leasing a section of the quarters occupied by the Auburn agency.

Woman Garage Proprietor—The Wollaston Garage at Quincy, Mass., is now being conducted by a woman, Miss McCabe, and she has worked out a novel way to advertise it by having flowers of all kinds tastefully planted about the place, making it unusual and attractive.

Large Garage for Baltimore—Plans are under way for one of the largest automobile garages south of New York. It will be built for William J. Tickner & Sons, Baltimore, Md. It will be 380 by 240 feet, thoroughly equipped and large enough to care for at least 150 machines. Day and night service will be arranged.

Motor Men in New Roles

Watt Heads N. Y. Swinehart Branch—F. D. Watt, formerly manager of the Philadelphia, Pa., branch of the Swinehart Tire and Rubber Co., is now manager of the company's New York City branch.

Stoddard Transferred—Harry Stoddard, who represented the Simms Magneto Co. in Detroit has been transferred to the home office at East Orange, N. J., where he is in charge of the sales department.

Shaw Heads Boston Scripps-Booth—The Scripps-Booth Co. has opened salesrooms in Boston, Mass., at 618 Commonwealth avenue, with A. V. Shaw, formerly with the Franklin agency, in charge of it.

Parker Is District Manager—F. G. Parker, who has been in the automobile field in Maine several years, but left some time ago has gone back to Portland where he is now in charge of the Maxwell Motor Co.

Haney Heads U. S. Tire Branch—The United States Tire Co. has opened a branch at Manchester, N. H., at 1128-38 Elm street, and J. P. Haney, who has been at the Boston branch has been placed in charge.

Mead Heads Stewart-Warner in Portland—A speedometer service station, representing the Stewart-Warner Speedometer Corp. for the Northwest, has been opened in Portland, Ore., at 333 Mead street, with C. H. Mead as manager.

Riley Resigns from Studebaker—N. J. Riley, assistant treasurer of the Studebaker Corp., South Bend, Ind., has resigned, so as to retire from active business permanently. Riley has been an officer of the company for more than 20 years.

Skeetop Returns to Boston—S. A. Skeetop, who had been identified with the Lexington line in Boston, Mass., and later in Providence, R. I., has returned to Boston to become manager of the H. S. Waite Co., agent for the Grant car in the Bay State.

Holly Mgr. Boston Garford—A. S. Holly, until recently manager of the J. C. Tucker Co.'s Boston branch, handling the Chase trucks, has been made manager of the R. E. Taylor Corp., that handles the Garford line in New England, with headquarters in Boston, Mass.

Soule Buys Out Branch—Arthur Soule, formerly of Windham, Me., who has been located at the Chicago agency of the Studebaker for the past 5 years, has returned to Portland, Me., where he has bought out the Studebaker branch located at the Central Garage on Oak street.

Wooler Chandler Designing Engineer—Ernest Wooler, who came over to the United States in 1913 as a member of the Institution of Automobile Engineers, to take up a position as designing engineer with the Continental Motor Mfg. Co., Detroit, has resigned to take a similar position with the Chandler Motor Car Co., Cleveland, O.

Fenstermacher Overland Distributor—S. E. Fenstermacher, of Berwin, Pa., has been appointed distributor for Willys-Overland cars for the northeastern district of Pennsylvania. His organization will be known as the Overland-Berwick Co., of Berwick, Pa. Mr. Fenstermacher has been an Overland dealer since the initial year of the Willys-Overland car.

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Dealer

Portland Locomobile Moves—The home of the Locomobile in Portland, Ore., has been removed to 490 Burnside street.

New Mohawk Tire Agents—The Southern Motors Co., Louisville, Ky.; the Scanlon Auto Tire & Supply Co., Rochester, N. Y.; The Erie Supply Co., Toledo, O.; W. J. Holliday Co., Indianapolis, Ind., and the Utica Cycle Co., Utica, N. Y., have recently taken on the distributor's proposition for Mohawk tires.

Packard's New Chicago Addition—A five-story fireproof reinforced concrete service station building is to be erected at 2336-40 Indiana avenue for the occupancy of the Packard Motor Car Co., Chicago, Ill. The building will occupy 70 by 150 feet, and will cost in the neighborhood of $125,000, and will be completed by October 1.

New Ford Service Station in Hartford—The Elmer Automobile Co. has purchased the Palace automobile station at 348 Trumbull street, Hartford, Conn. This property is occupied by the Palace Auto Service Co., Mitchell and Oldsmobile representatives. Mr. Elmer plans to convert the big garage, one of the very first in this city, into a Ford service station. The Palace company will continue to occupy the front of the building. The Elmer company does the largest business of any of the local concerns, having the Ford in five counties of the state.